MACHINE SHOP PRIMER

MACHINE SHOP PRIMER

AN INTRODUCTION TO MACHINE TOOLS AND SHOP APPLIANCES, WITH ILLUSTRATIONS, NAMES AND DEFINITIONS

BY

FRED H. COLVIN, A. S. M. E.

ASSOCIATE EDITOR OF THE AMERICAN MACHINIST, AUTHOR OF "MACHINE SHOP ARITHMETIC," "MACHINE SHOP CALCULATIONS," "THE HILL KINK BOOKS," ETC., ETC.

AND

FRANK A. STANLEY

ASSOCIATE EDITOR OF THE AMERICAN MACHINIST, AUTHOR OF "ACCURATE TOOL WORK," "AUTOMATIC SCREW MACHINES," "THE HILL KINK BOOKS," ETC., ETC.

FIRST EDITION

SECOND IMPRESSION

McGRAW-HILL BOOK COMPANY

239 WEST 39TH STREET, NEW YORK

6 BOUVERIE STREET, LONDON, E. C.

1910

Printed and Electrotyped by
The Maple Press
York, Pa.

PREFACE

The first step toward a clear understanding of practical shop work is a knowledge of the names of the machines, tools, and appliances used. This book has been prepared to aid both students and instructors in this line of work.

The unusual arrangement is the result of careful consideration and of consultation with Mr. J. Howard Renshaw and other successful instructors in industrial lines.

The first section can be used as a sketch book and from it the learner or apprentice can see just what a tool looks like. Should he fail to remember its name, he can refer to the next section.

The second section gives the correct name of every part illustrated. The proper spelling of the names and terms used are an essential part of this work and this section will be found a practical spelling book.

The third section is a very complete and convenient reference book on mechanical subjects. It contains much general information in such form as to be readily understood.

It is hoped this book will prove of assistance to those who are in any way interested in industrial education.

THE AUTHORS.

SECTION I

Contains 508 illustrations of machines, tools, and machine-shop appliances. The names will be found in Section II with a corresponding number. Section III gives more detailed information about them.

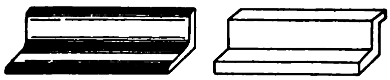


Fig. 1.

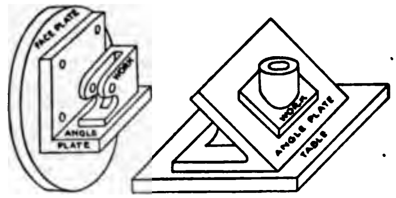


Fig. 2.

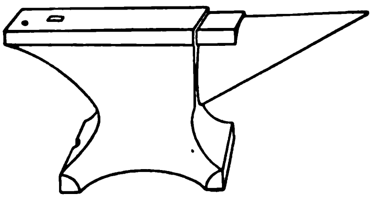


Fig. 3.

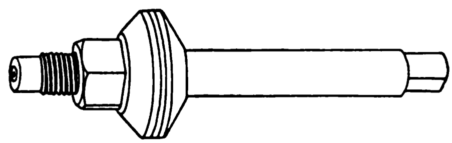


Fig. 4.

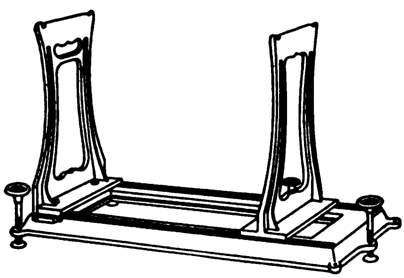
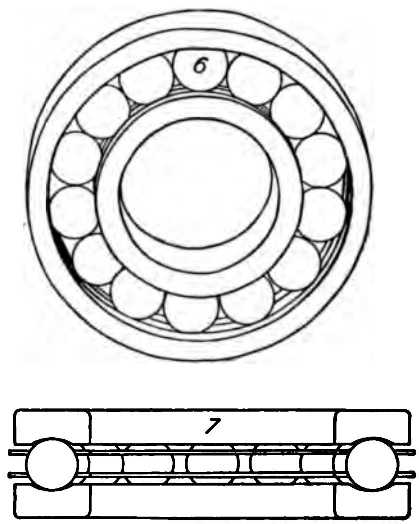


Fig. 5.



Figs. 6–7.

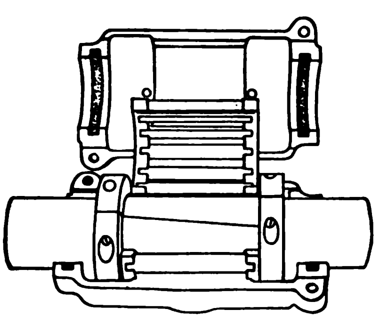


Fig. 8.

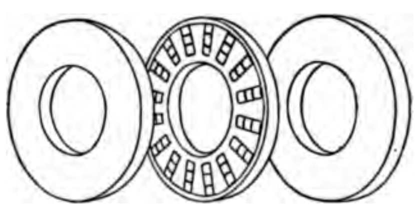
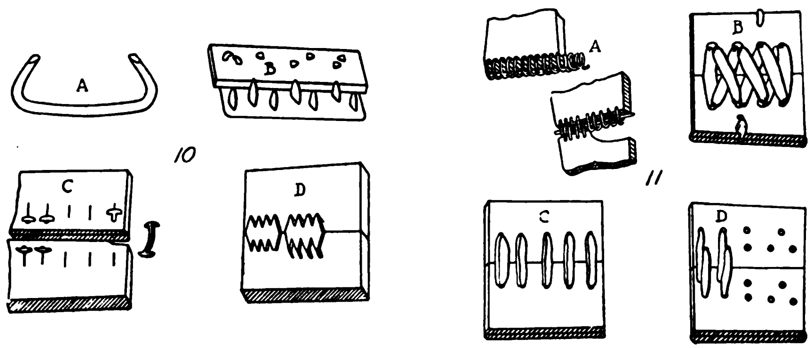


Fig. 9.



Figs. 10–11.

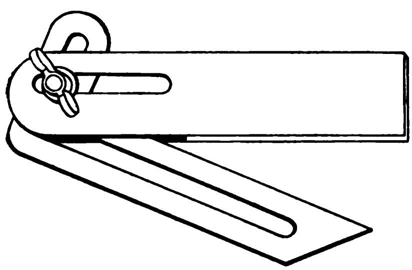
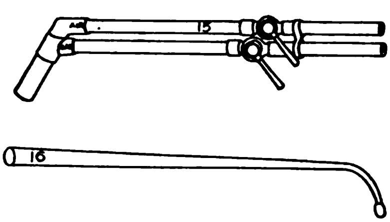
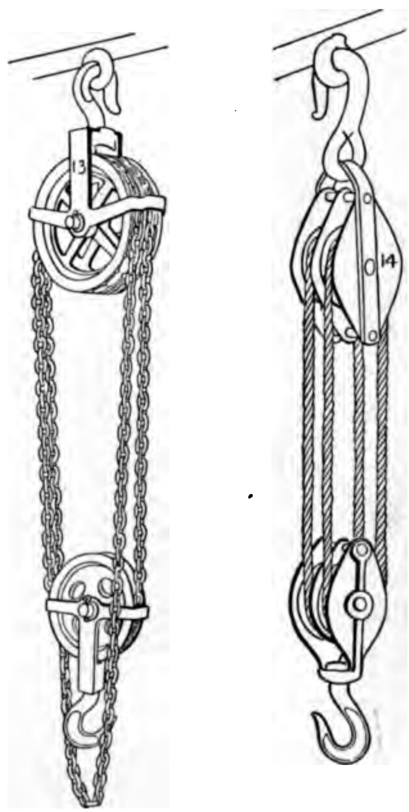


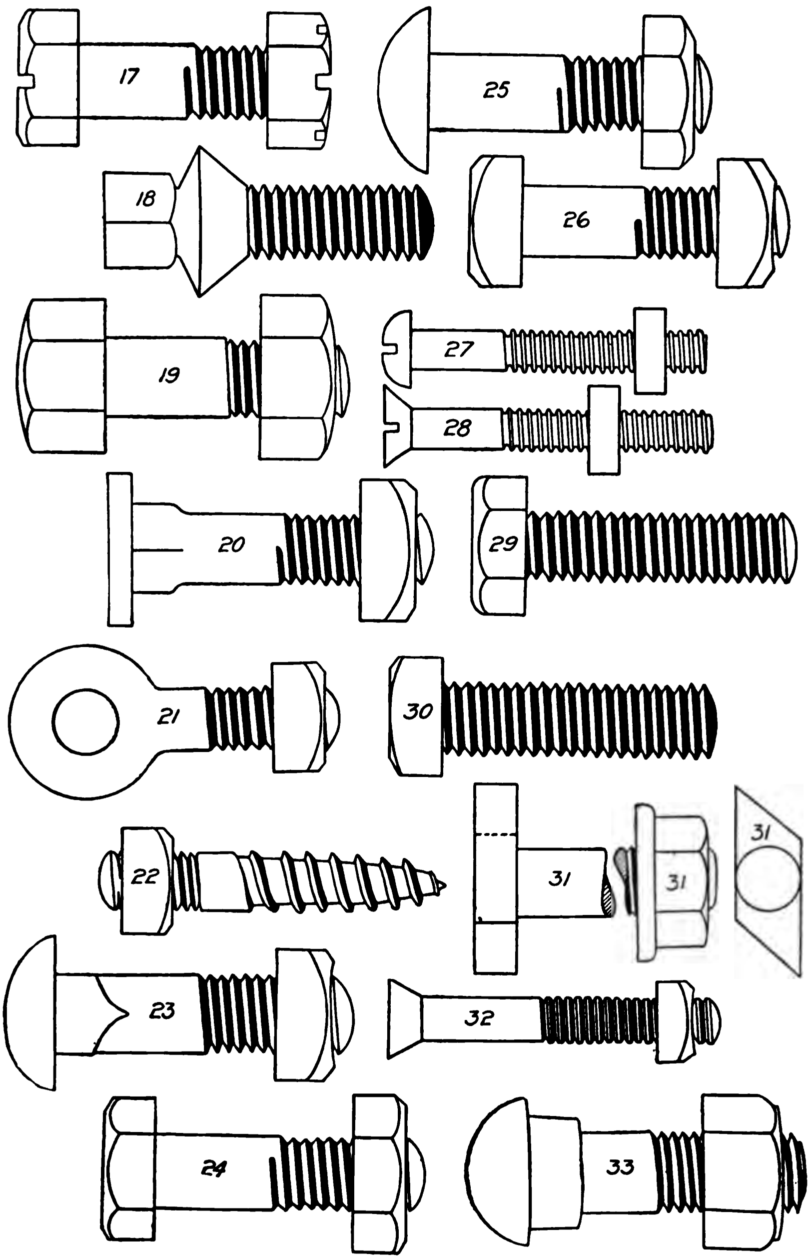
Fig. 12.



Figs. 15–16.



Figs. 13–14.



Figs. 17–33.

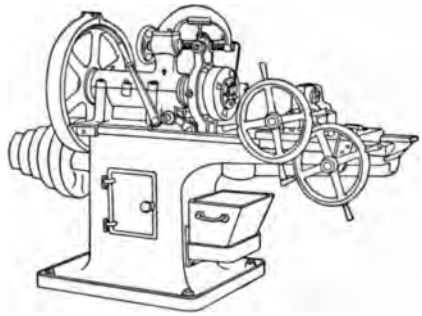


Fig. 34.

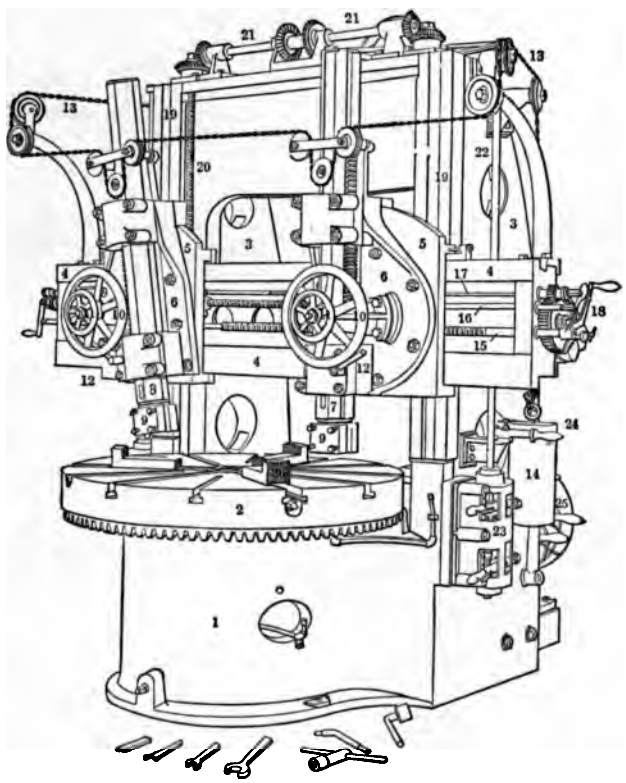

21
21
13
13
19
20
22
19
3
3
5
5
3
4
4
17
6
6
10
16
18
15
4
12
12
12
8
7
9
9
24
14
2
23
25
1

Fig. 35.

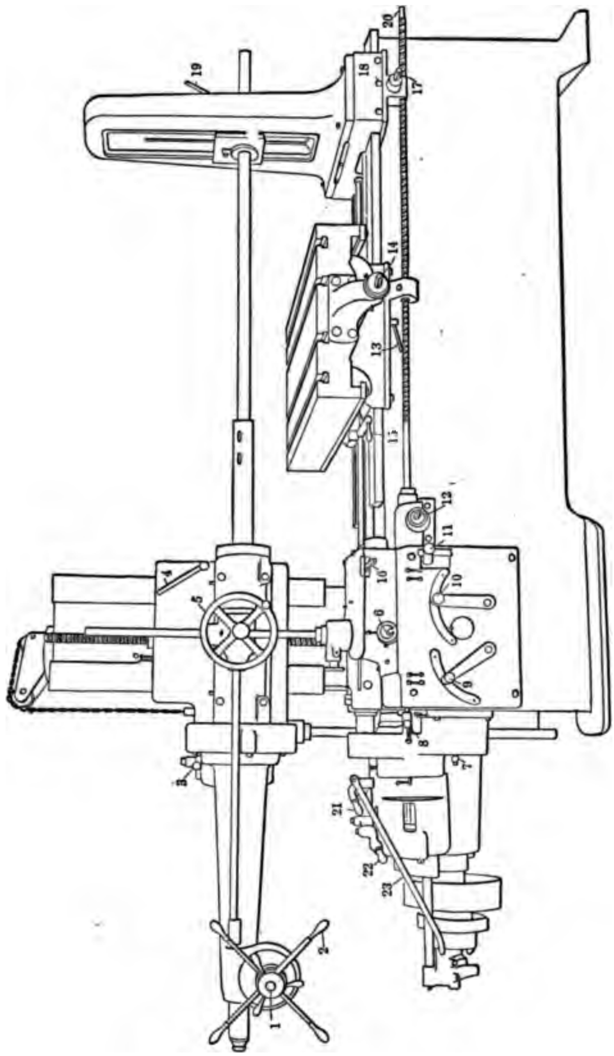
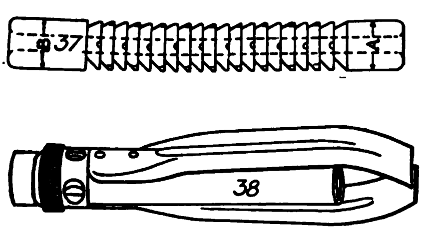


Fig. 36.



Figs. 37–38.

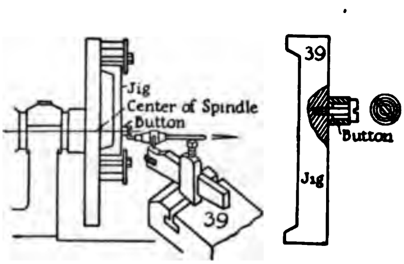
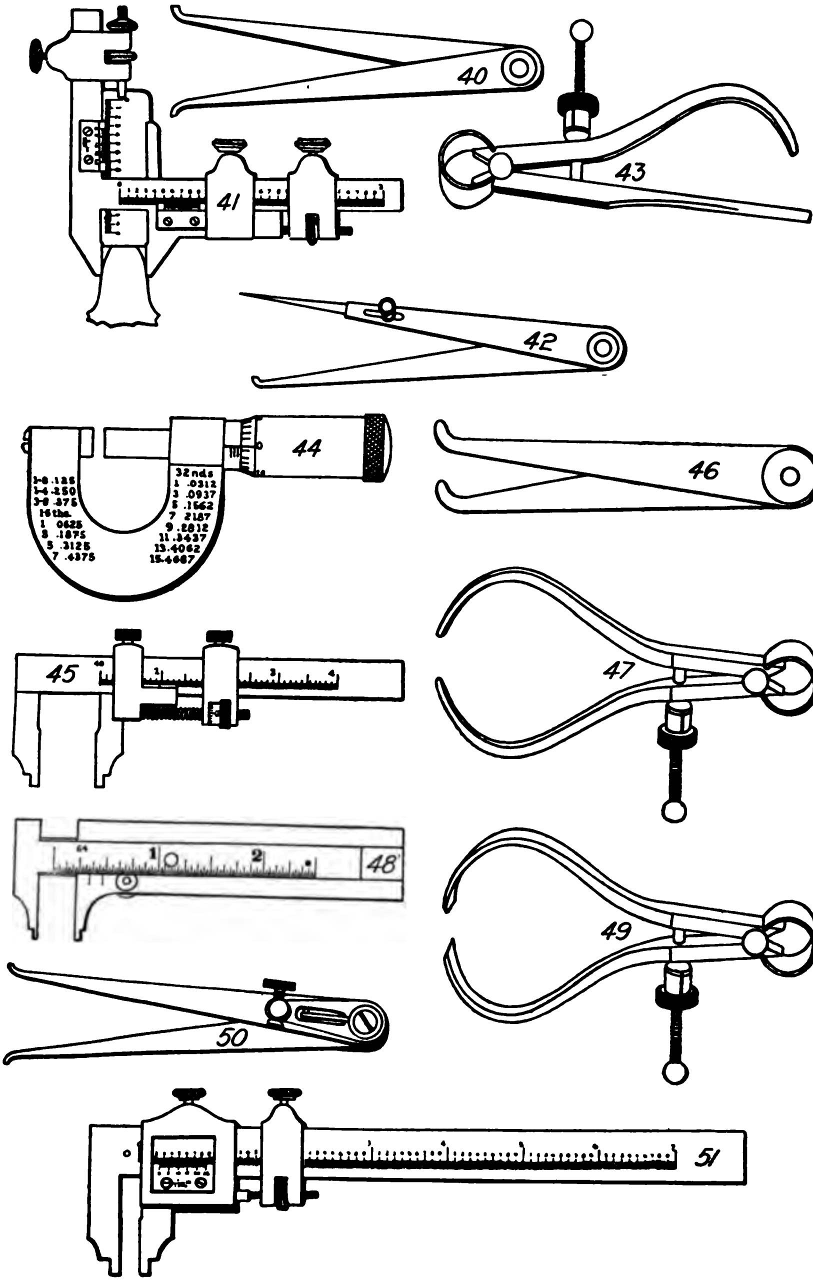
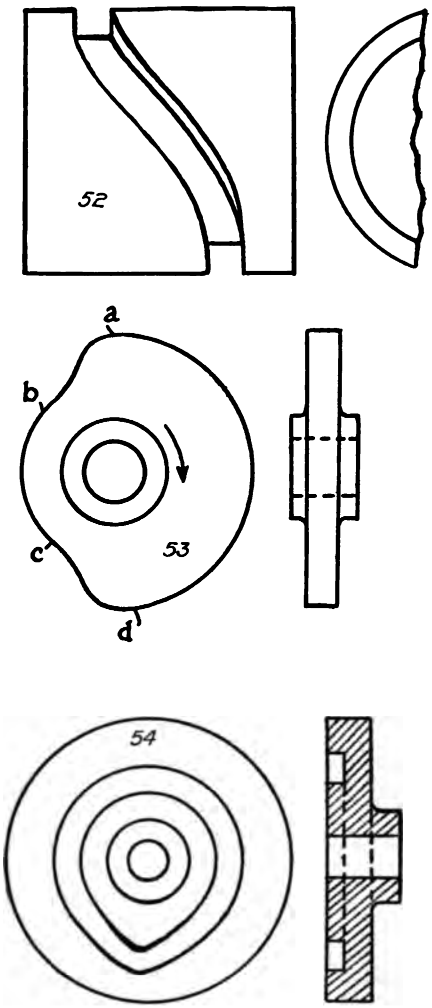


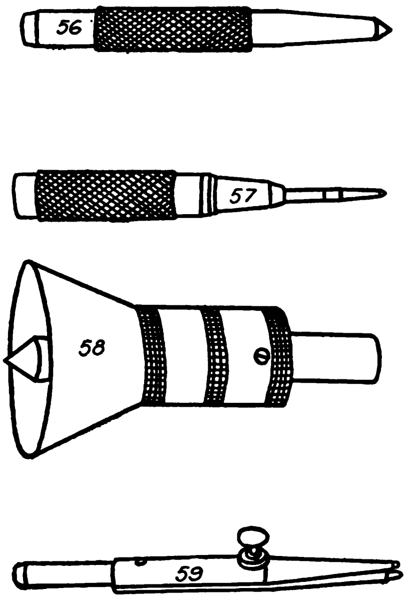
Fig. 39.



Figs. 40–51.



Figs. 52–54.



Figs. 56–59.

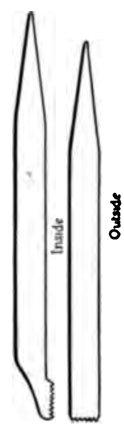


Fig. 60.

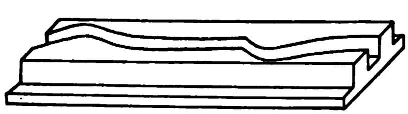


Fig. 55.

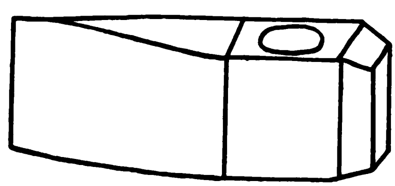
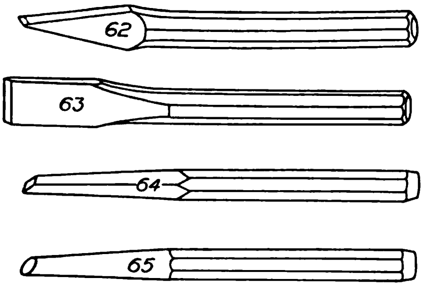


Fig. 61.



Figs. 62–65.

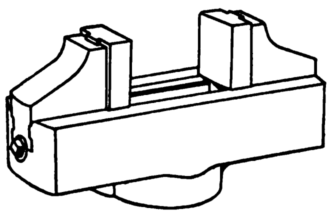


Fig. 66.

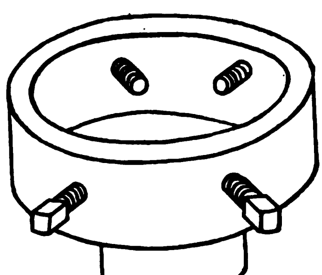


Fig. 67.

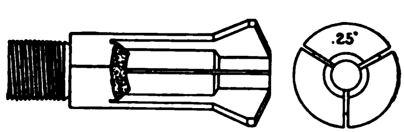


Fig. 68.

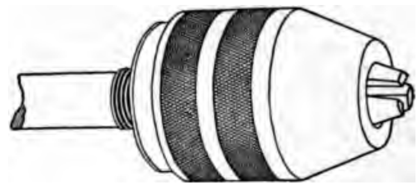


Fig. 69.

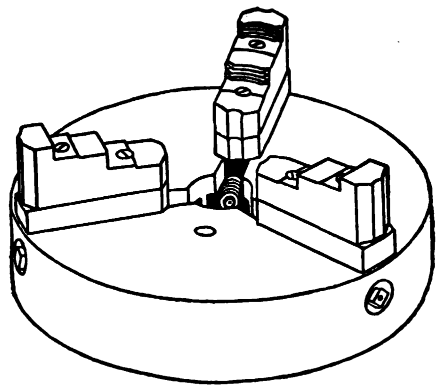


Fig. 70.

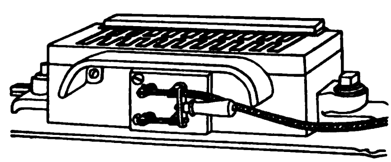


Fig. 71.

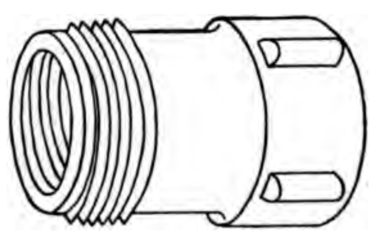


Fig. 72.

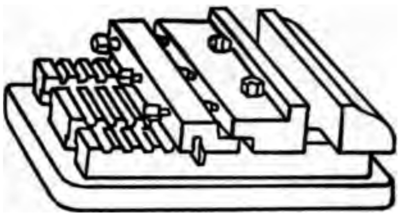


Fig. 73.

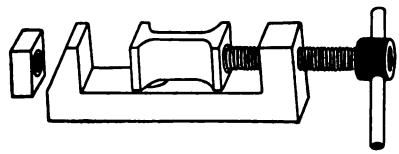


Fig. 77.

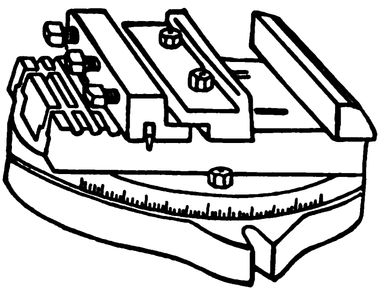


Fig. 74.

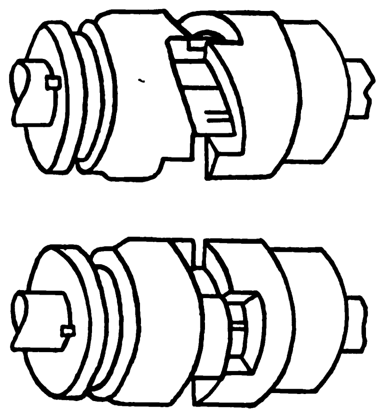
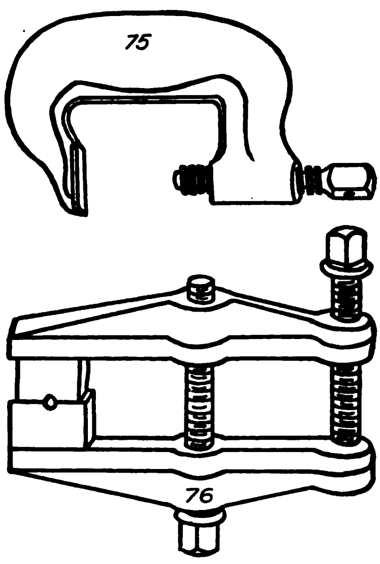


Fig. 78.



Figs. 75-76.

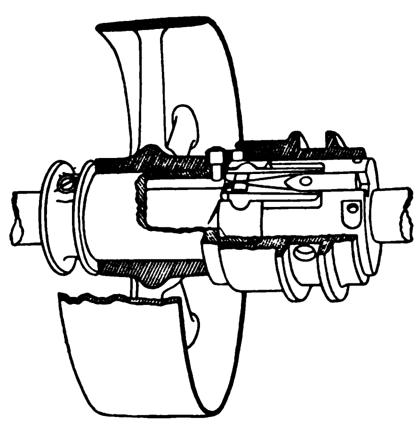
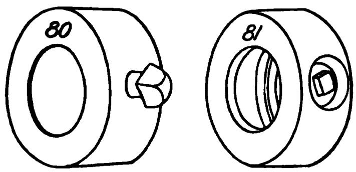


Fig. 79.



Figs. 80–81.

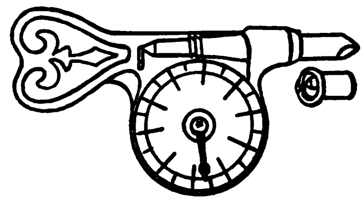


Fig. 83.

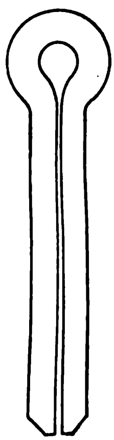


Fig. 82.

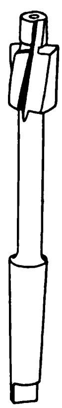


Fig. 84.

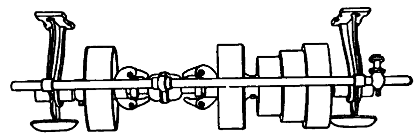


Fig. 85.

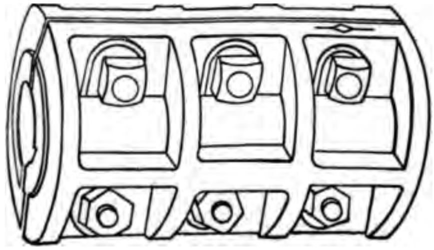
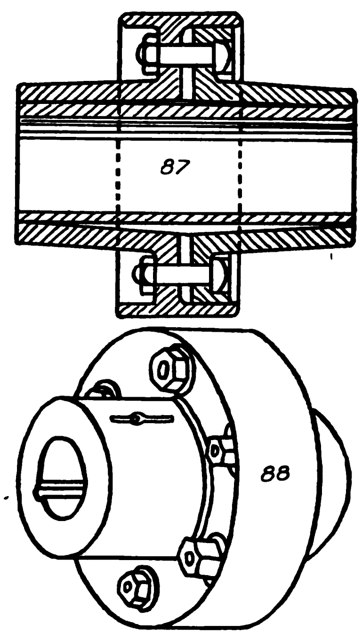


Fig. 86.



Figs. 87–88.

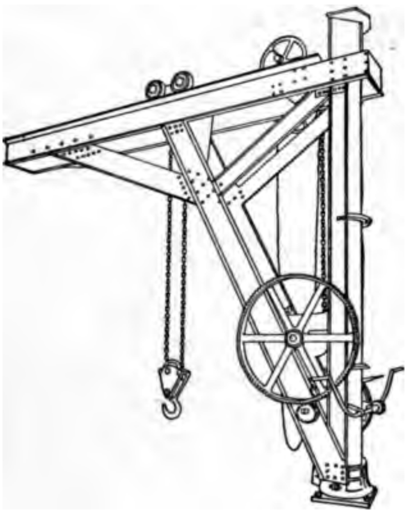


Fig. 89.

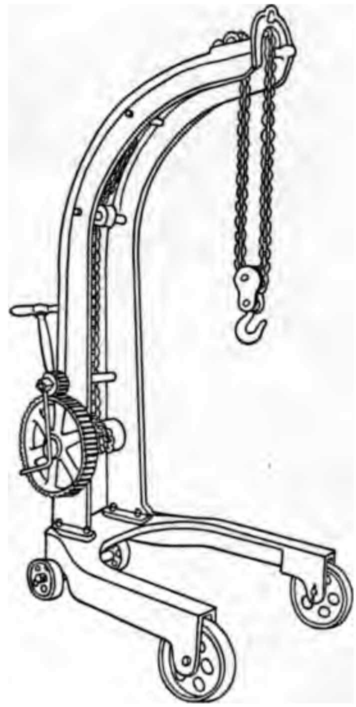


Fig. 90.

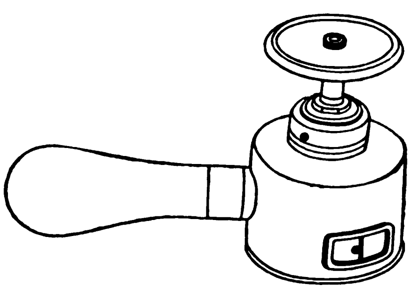


Fig. 91.

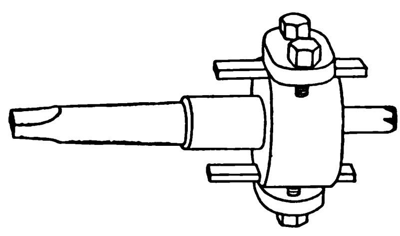
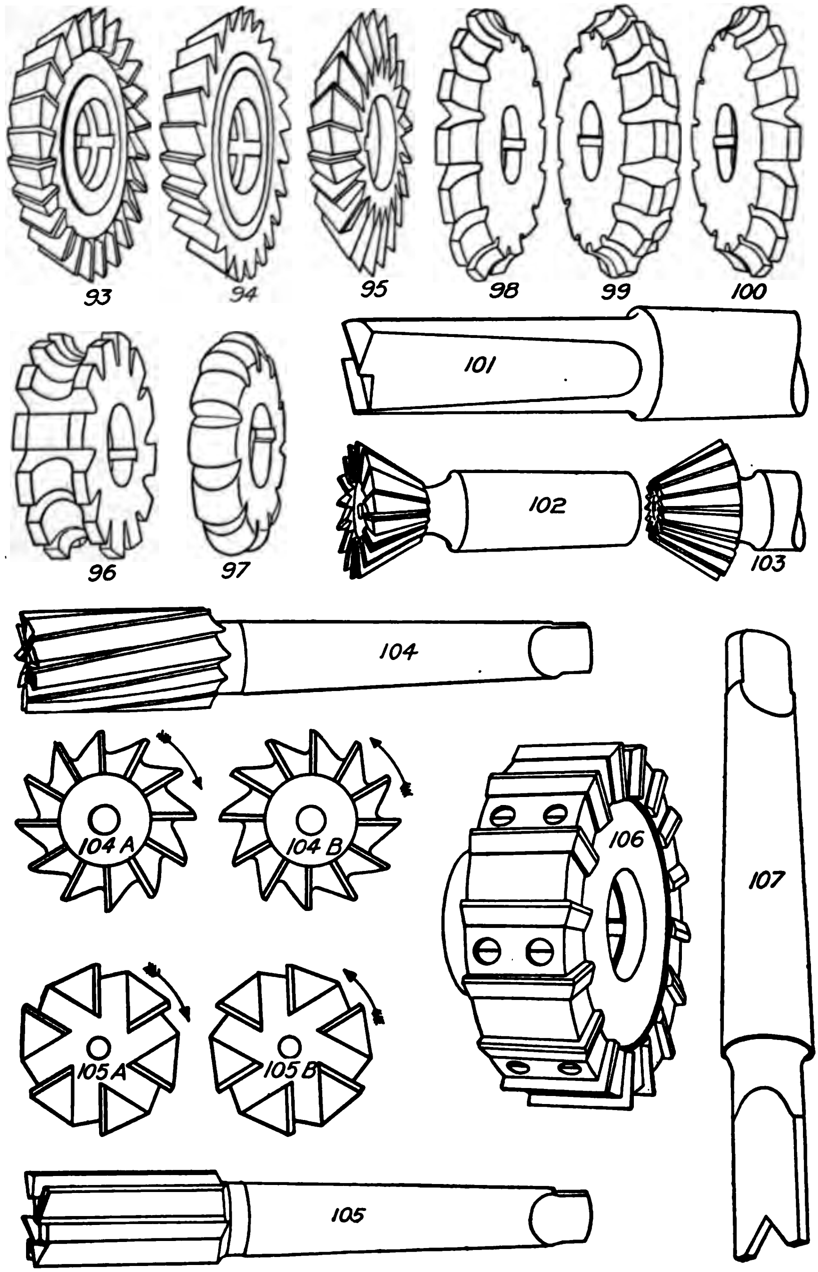
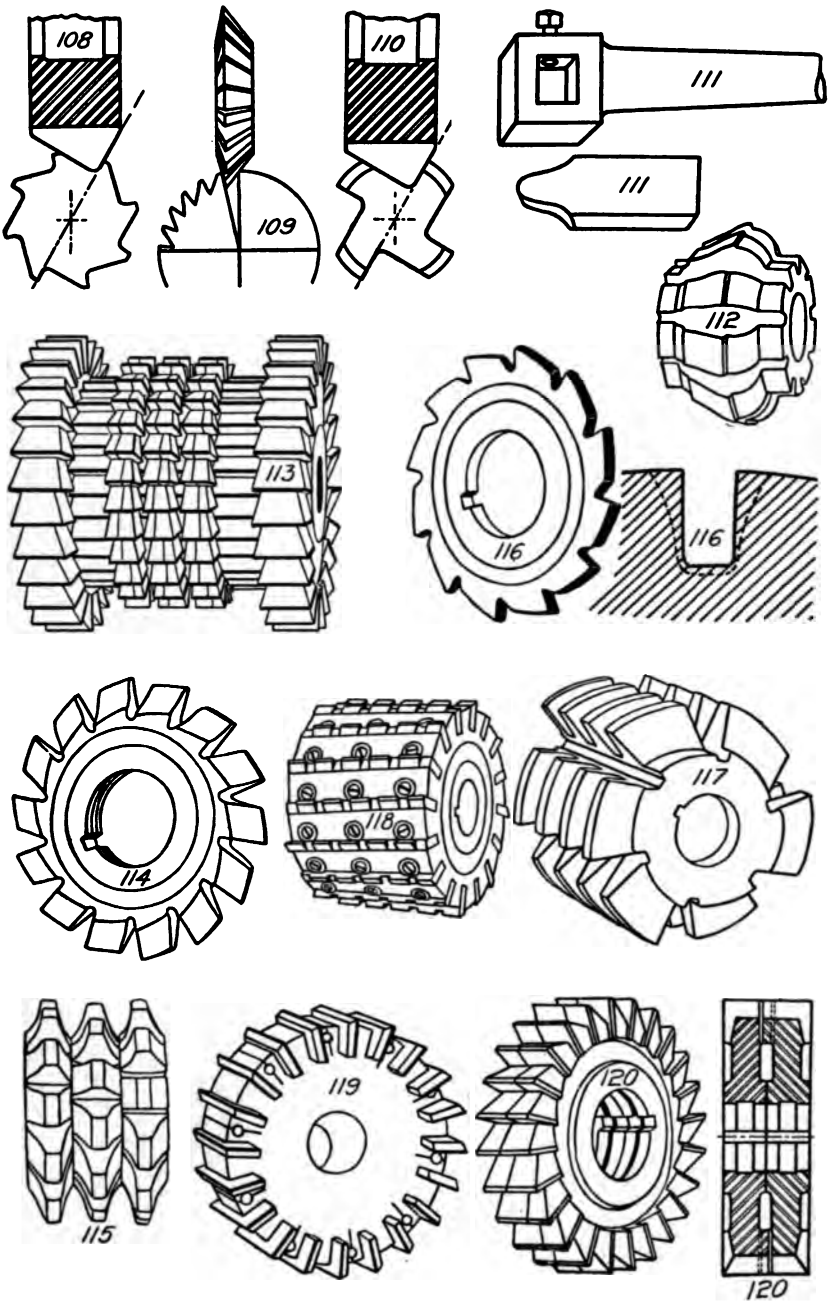


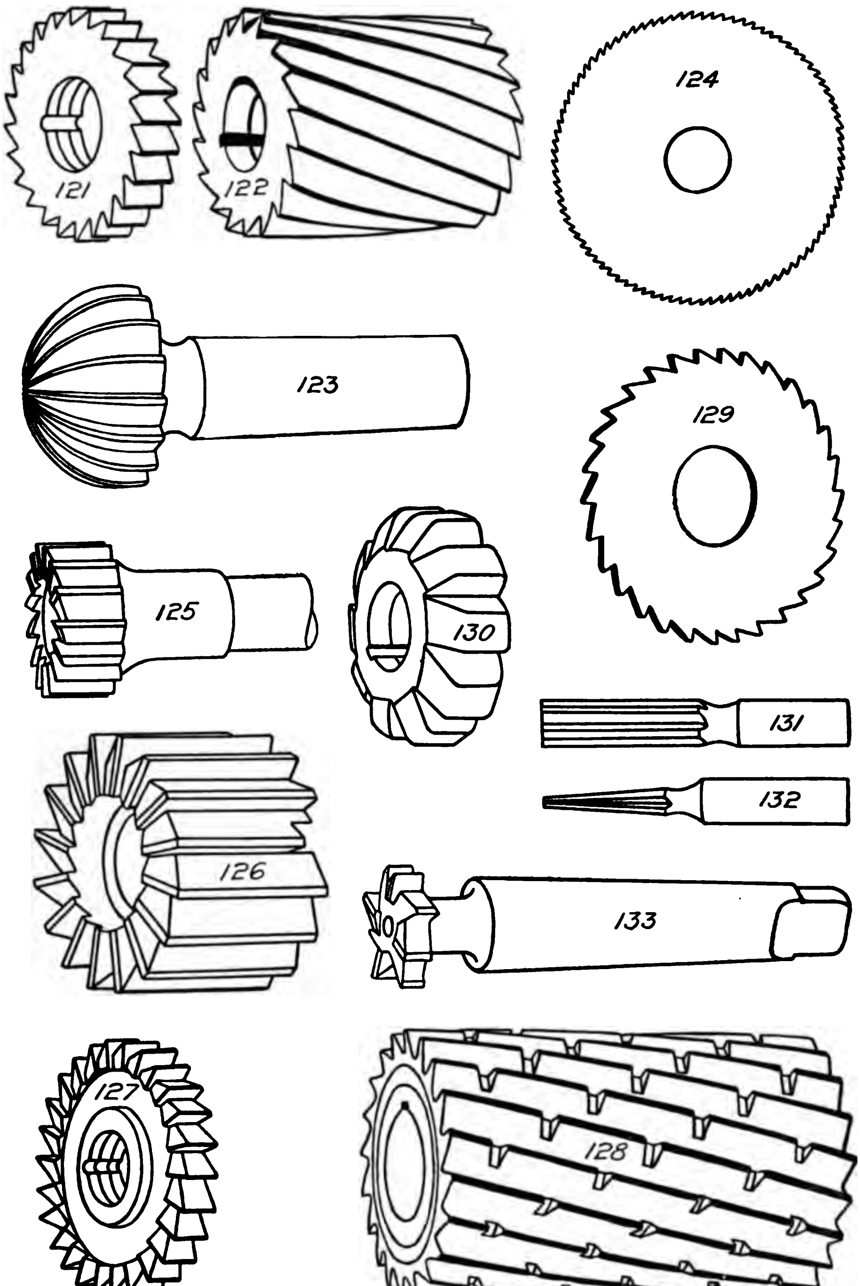
Fig. 92.


93
94
95
98
99
100
96
97
101
102
103
104
104 A
104 B
106
107
105 A
105 B
105

Figs. 93–107.



Figs. 108–120.



Figs. 121–133.

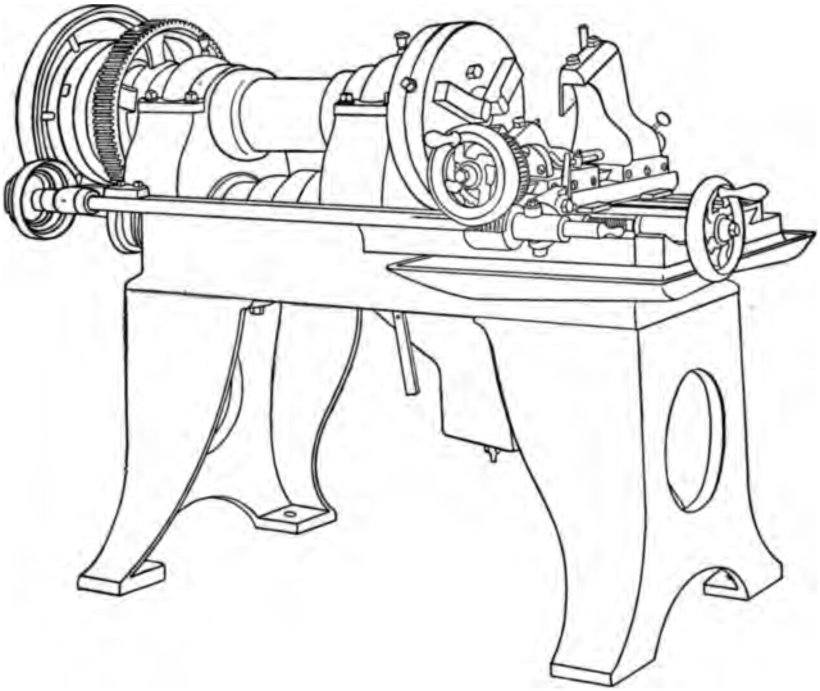
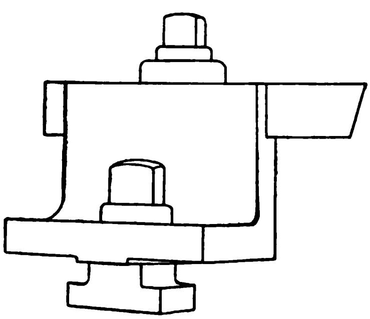


Fig. 134.



Eig. 135.

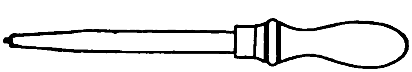


Fig. 136.

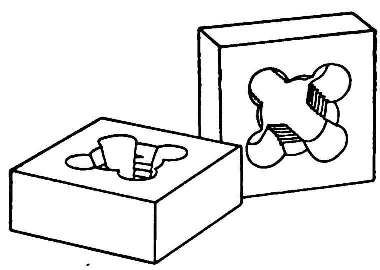


Fig. 137.

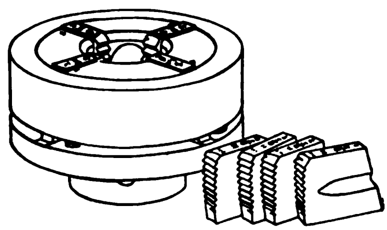


Fig. 138.

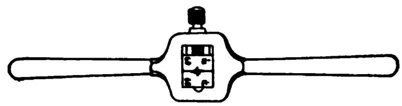
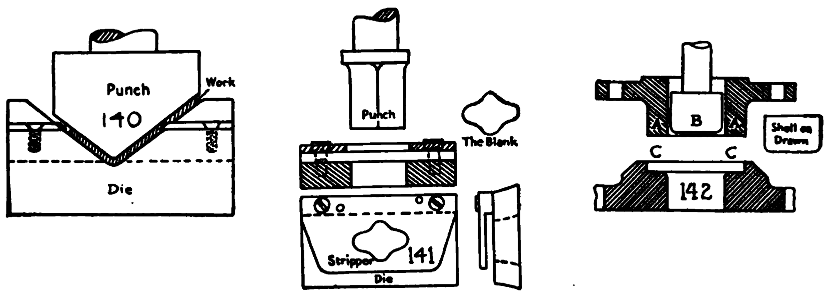


Fig. 139.



Figs. 140–142

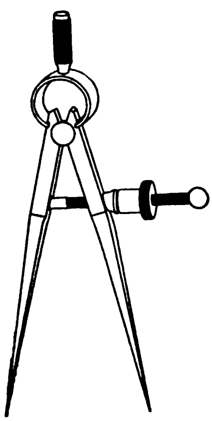


Fig. 143.

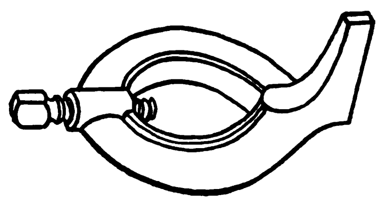


Fig. 144.

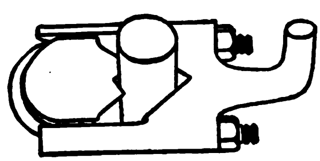


Fig. 145.

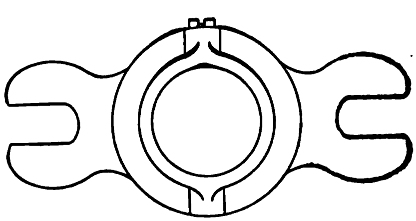


Fig. 146.

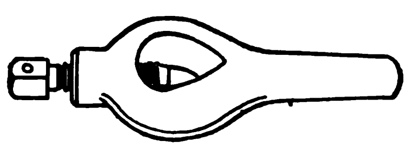
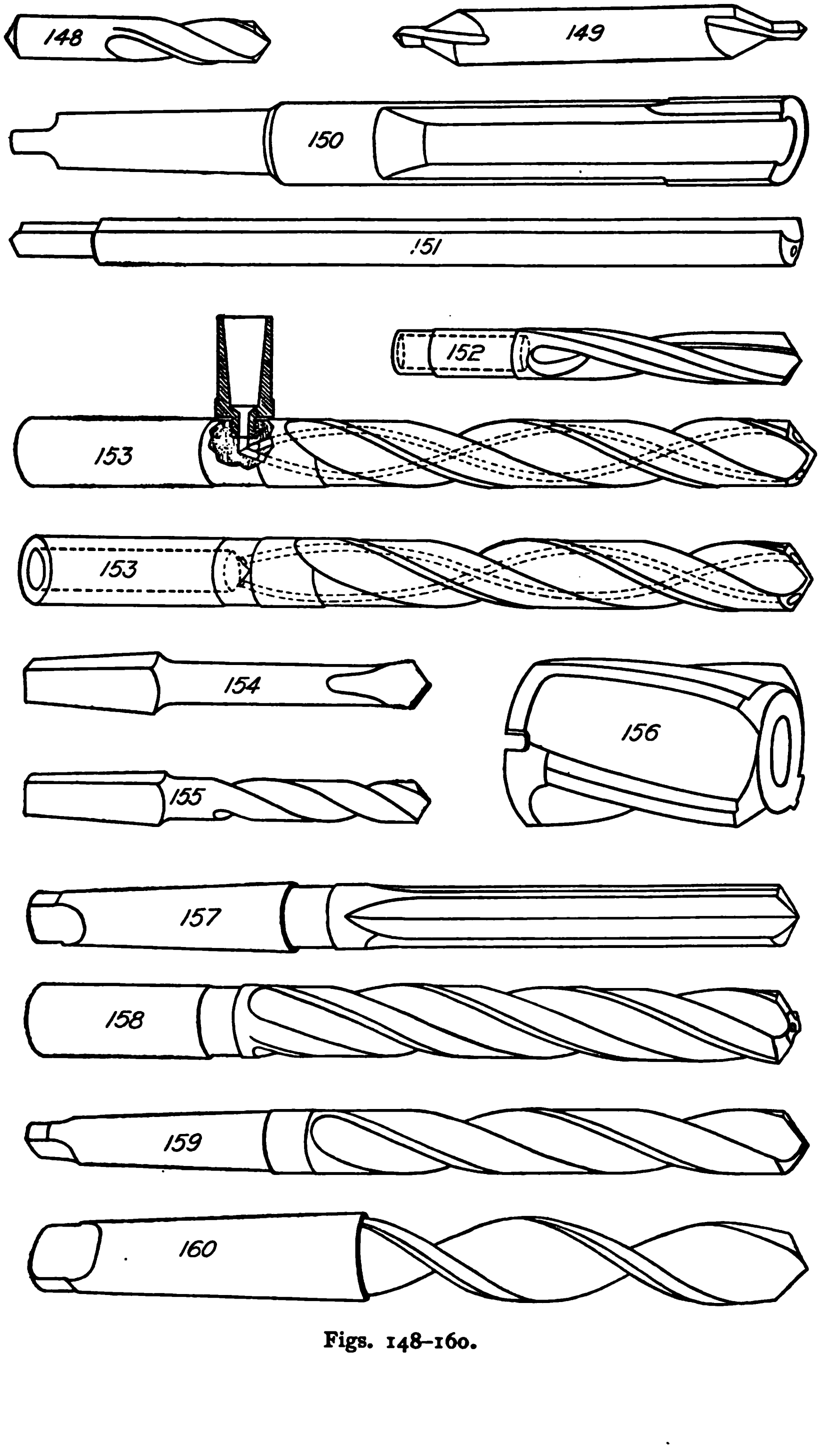


Fig. 147.



Figs. 148–160.

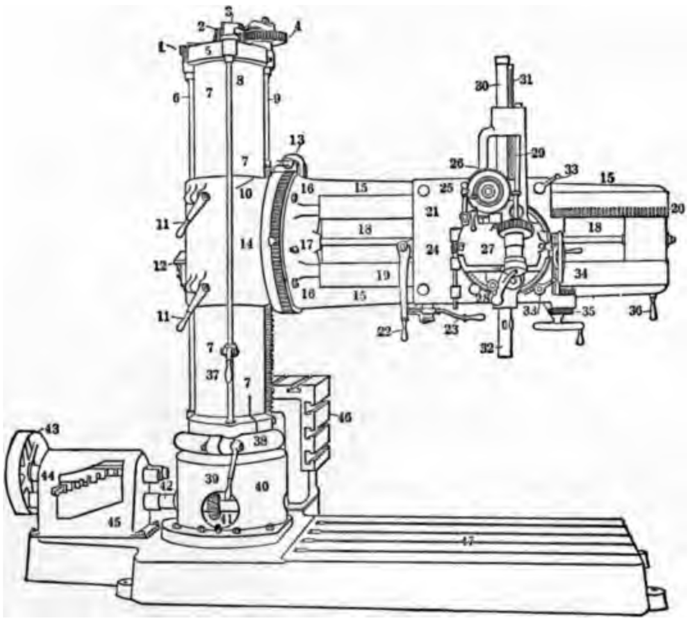


Fig. 161.

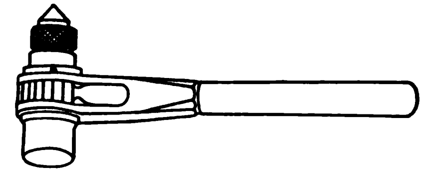


Fig. 162.

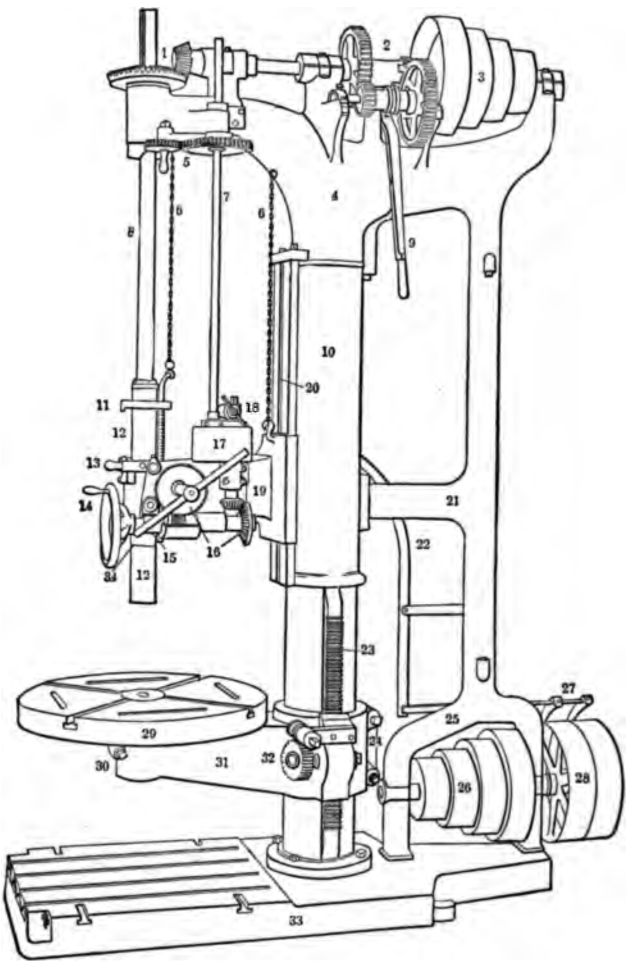
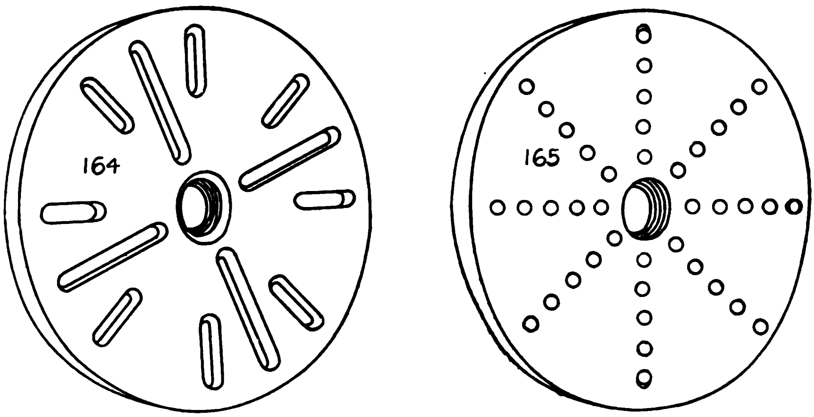
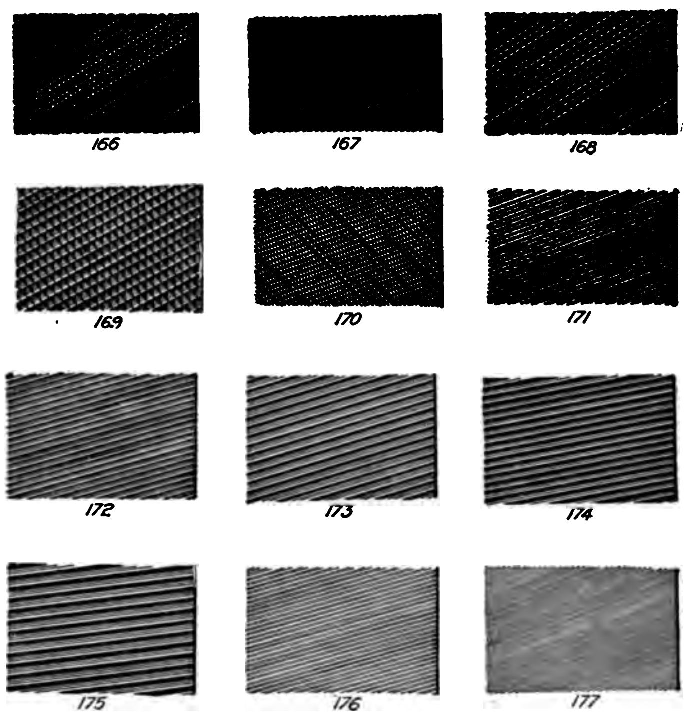

1
2
3
4
5
6
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
12

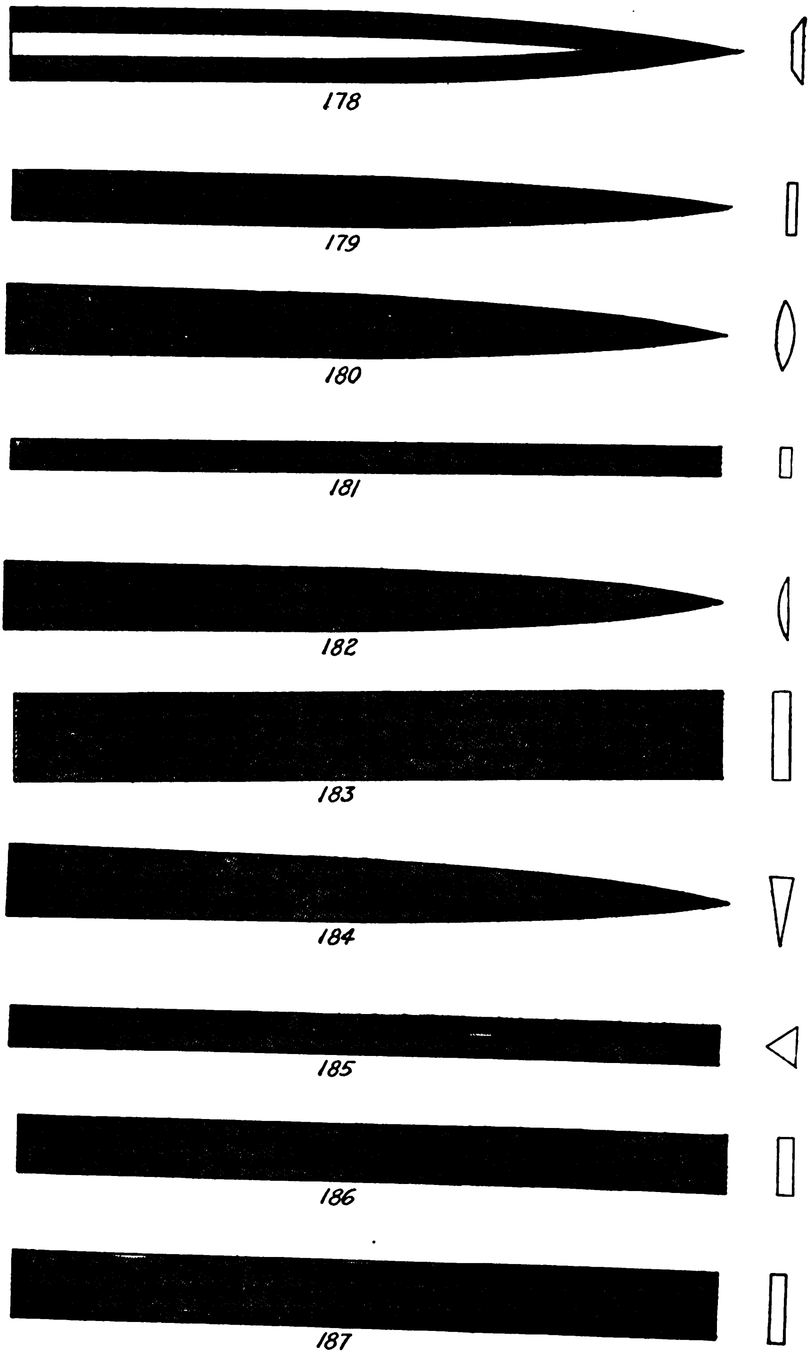
Fig. 163.



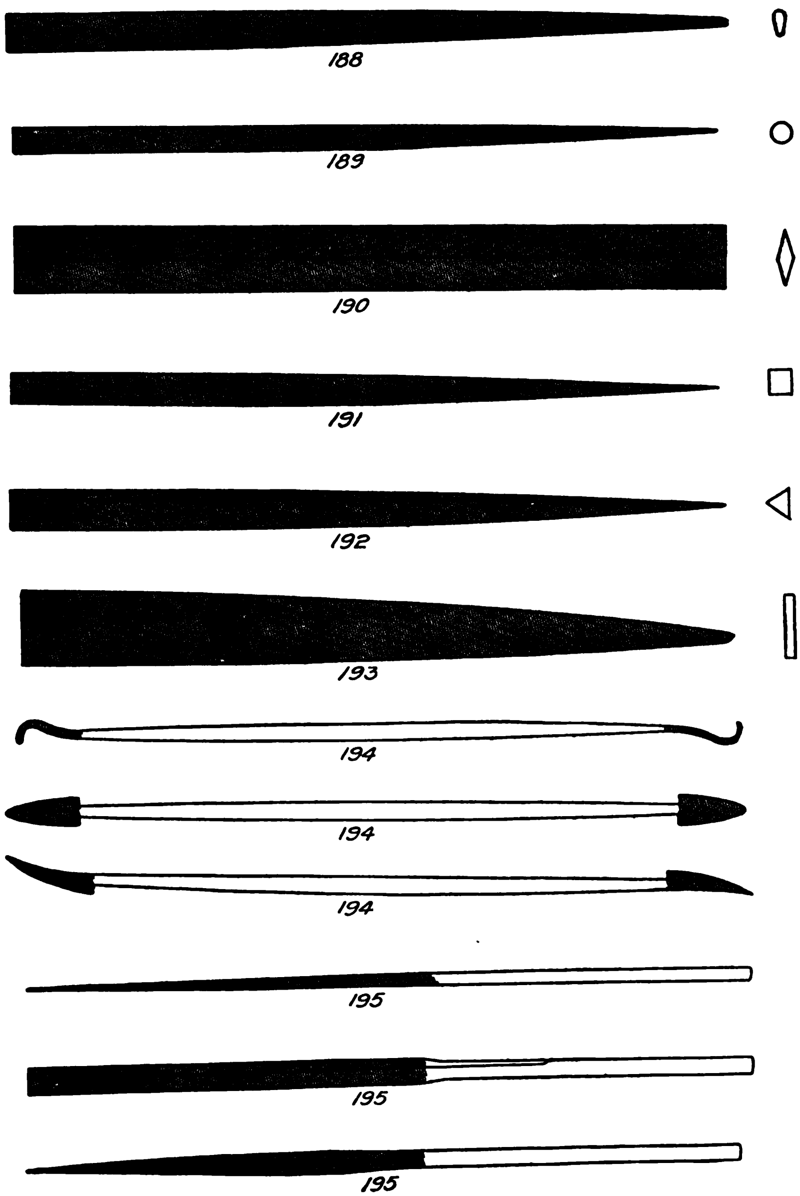
Figs. 164–165.



Figs. 166–177.



Figs. 178–187.



Figs. 188–195.

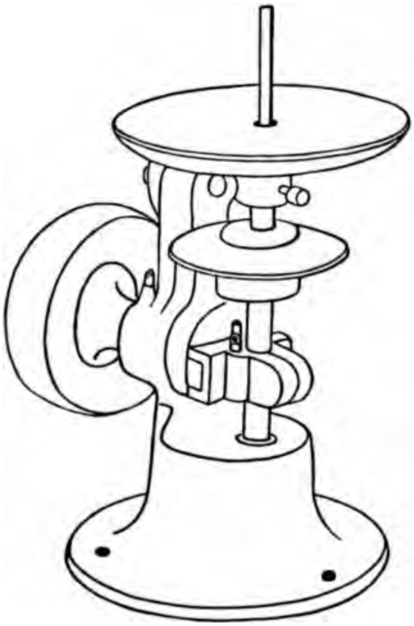


Fig. 196.

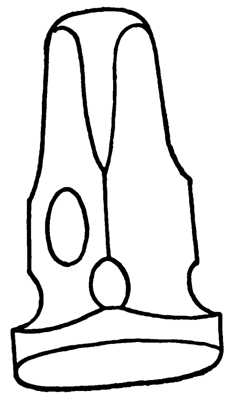


Fig. 197.

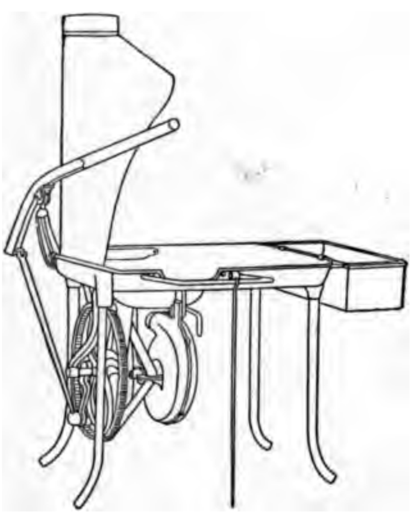


Fig. 198.

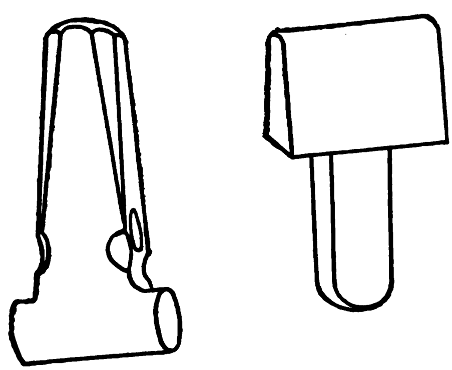
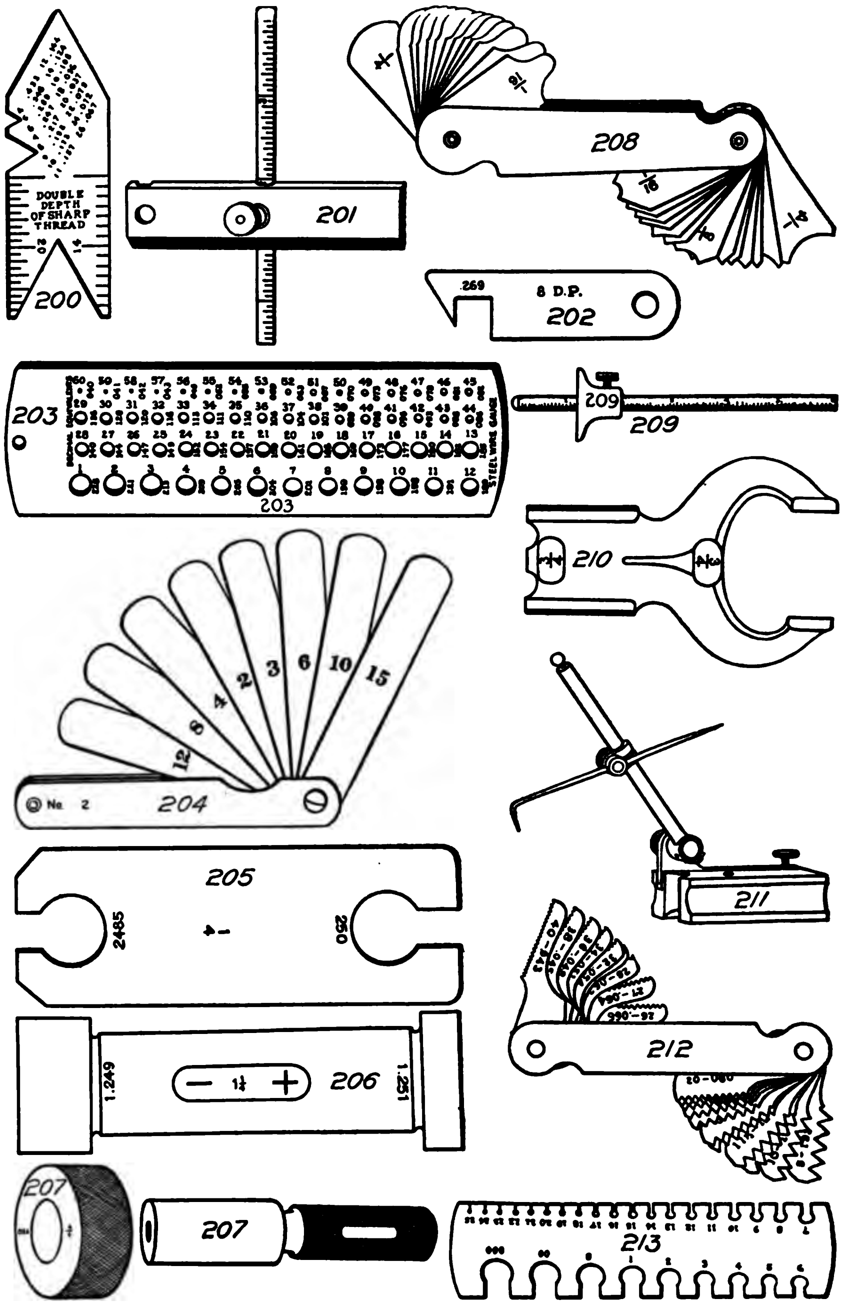
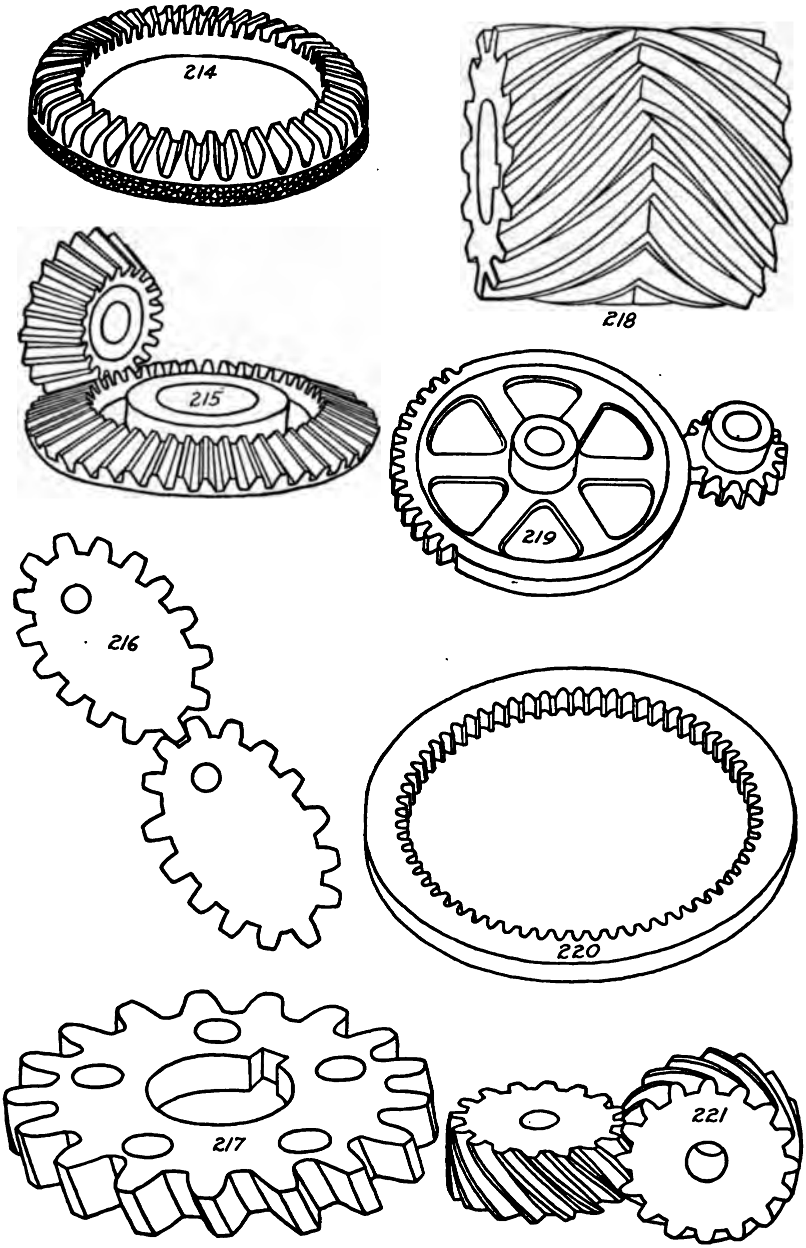


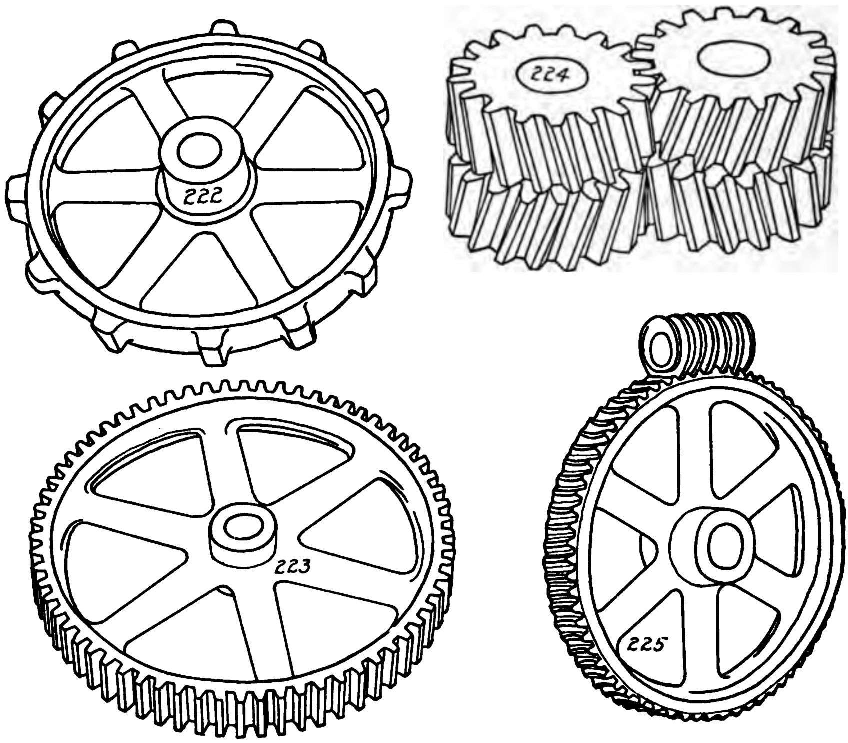
Fig. 199.


200
DOUBLE DEPTH OF SHARP THREAD
201
208
202
8 D.P.
.269
203
209
210
204
No. 2
211
205
2485
250
206
1.249
1.251
212
207
213

Figs. 200–213.



Figs. 214–221.



Figs. 222–225.

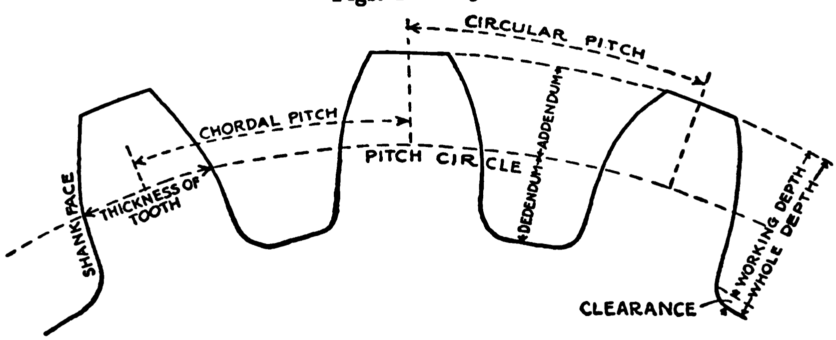


Fig. 226.

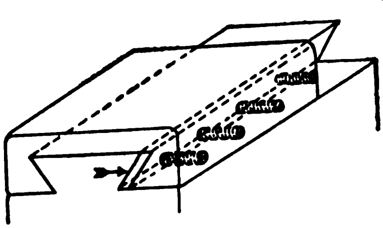


Fig. 227.

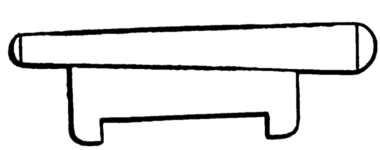
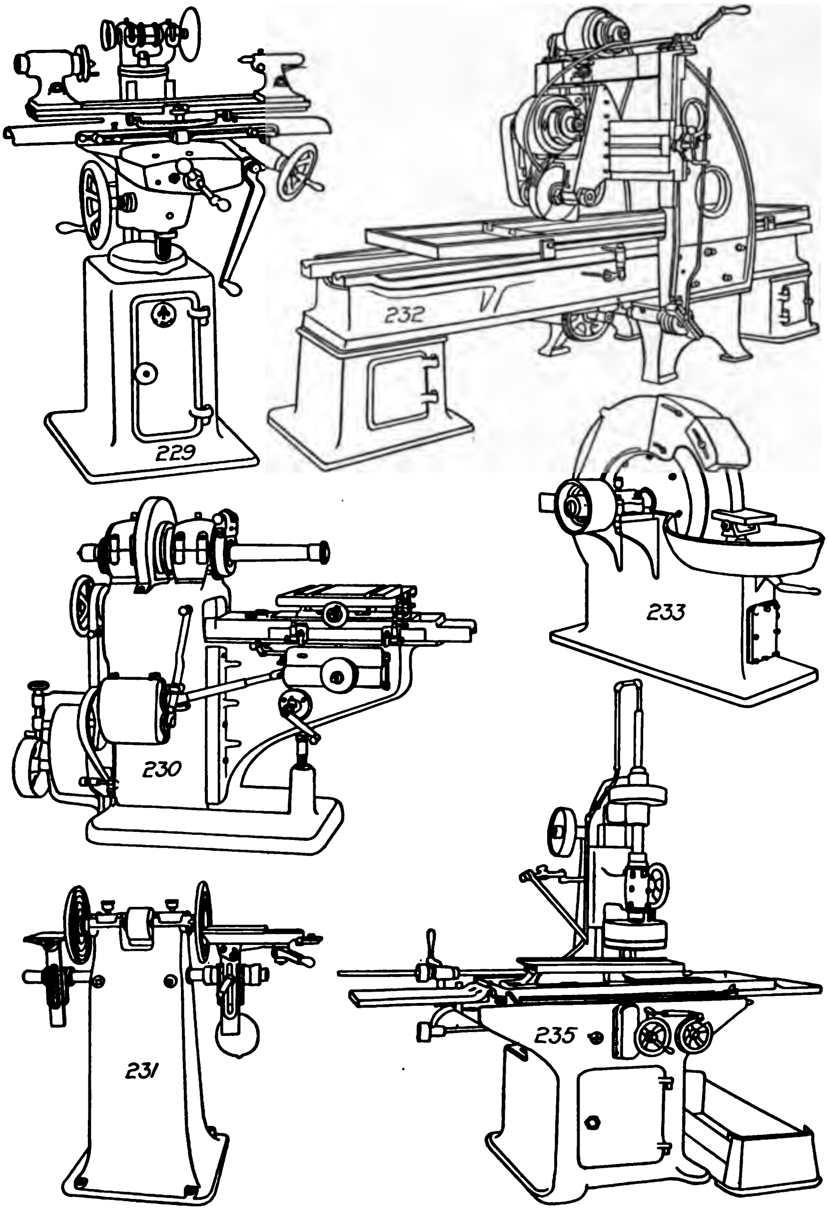


Fig. 228.



Figs. 229–235. (Fig. 234 next sheet.)

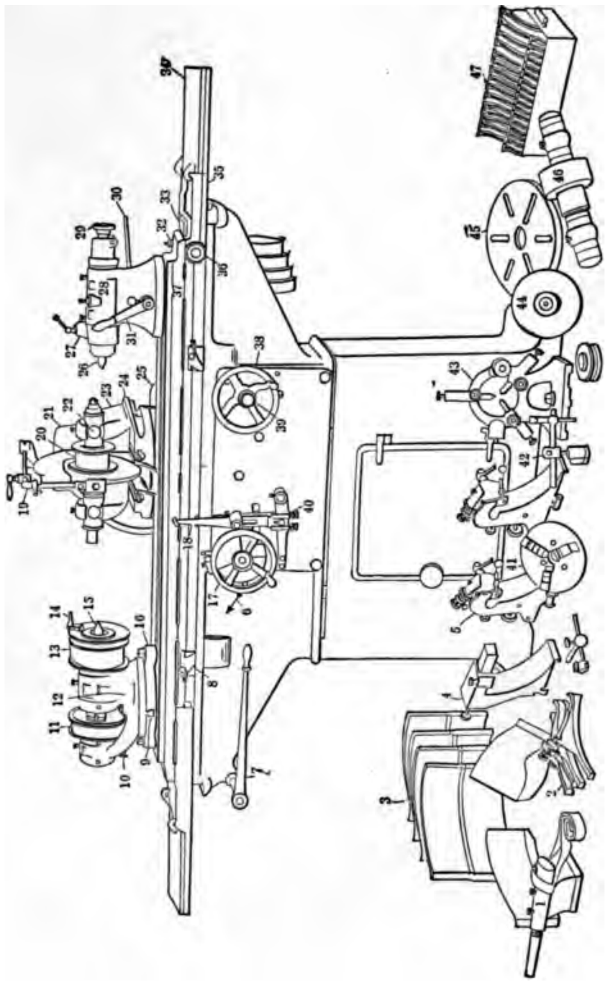
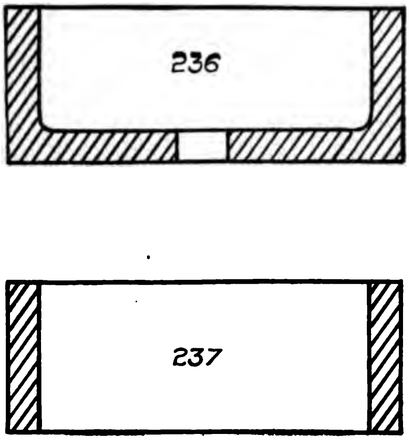
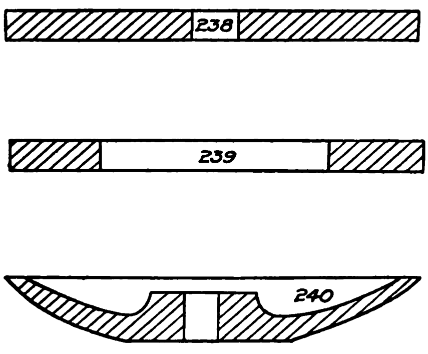


Fig. 234.



Figs. 236–237.



Figs. 238–240.

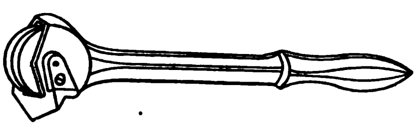


Fig. 241.

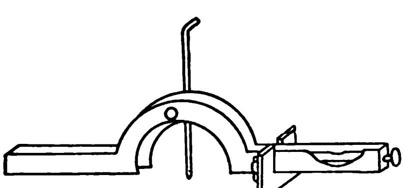
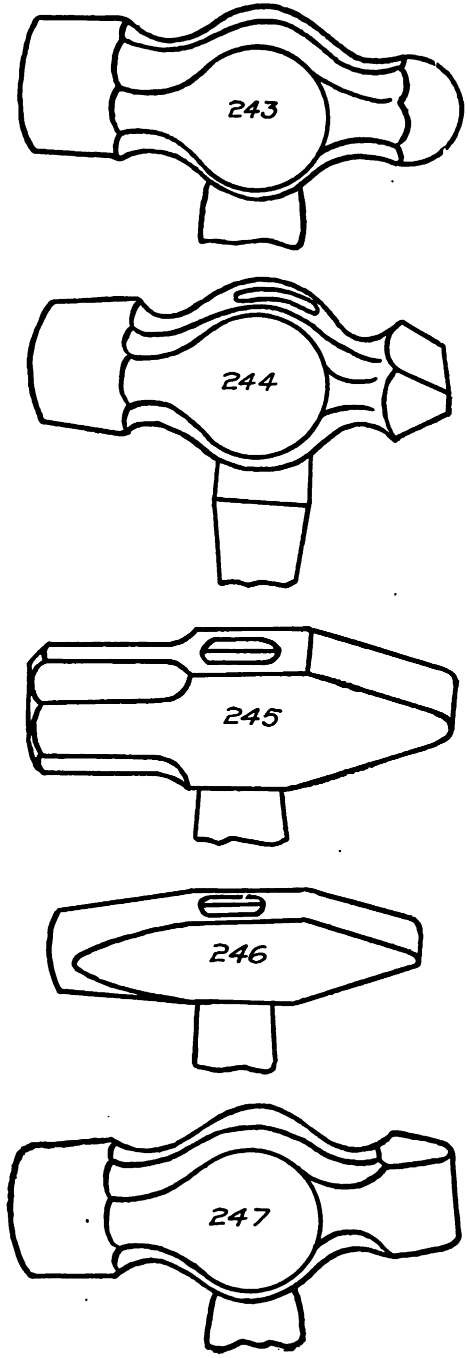


Fig. 242.



Figs. 243–247.

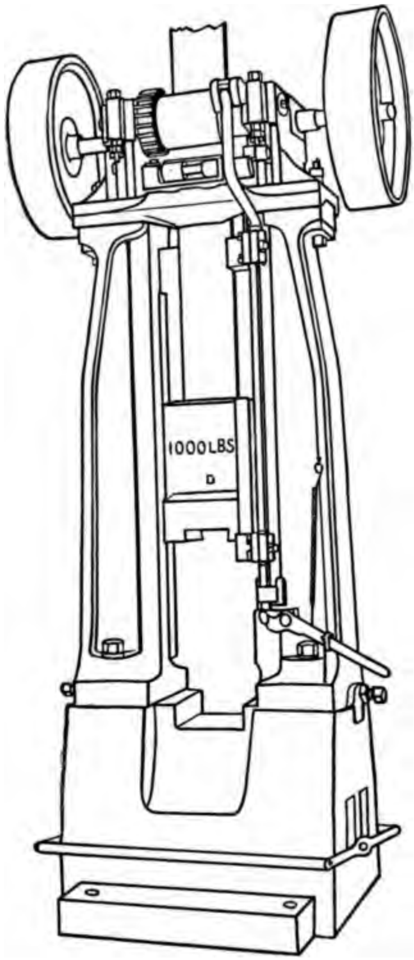


Fig. 248.

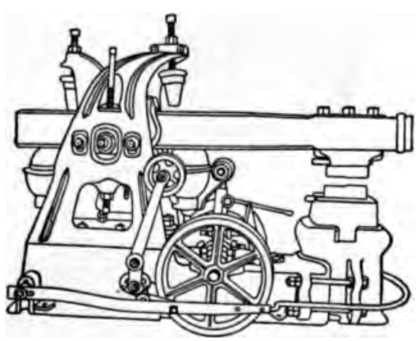


Fig. 249.

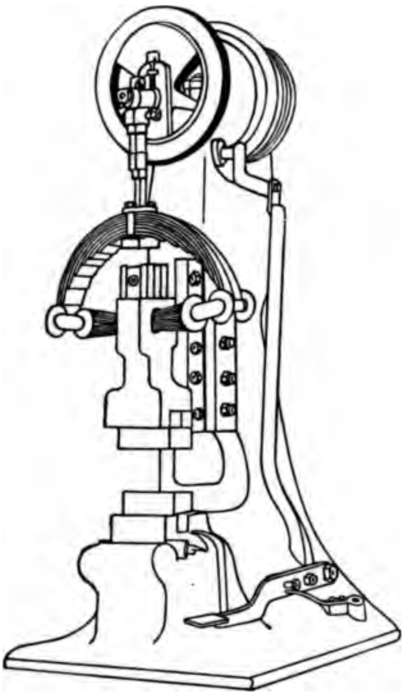


Fig. 250.

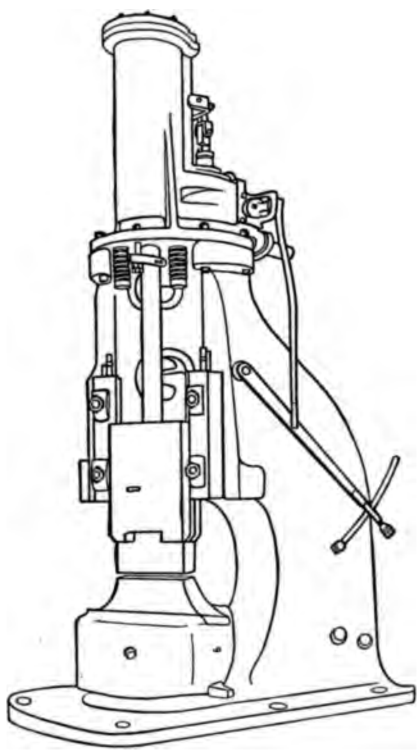
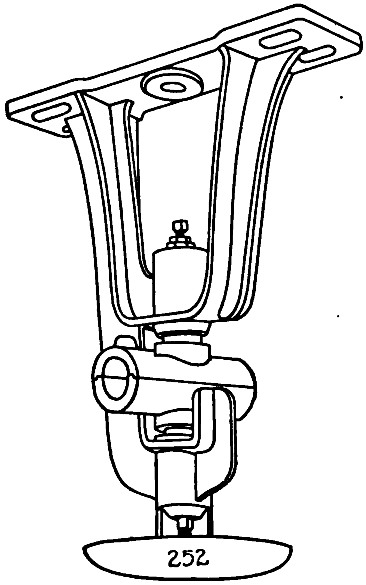
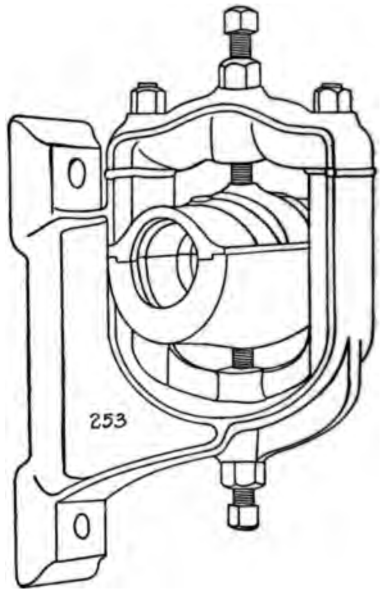


Fig. 251.





Figs. 252–253.

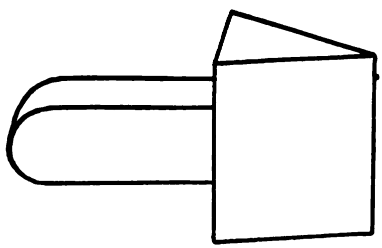


Fig. 254.

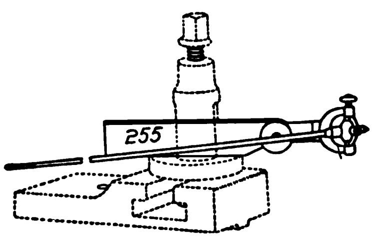


Fig. 255.

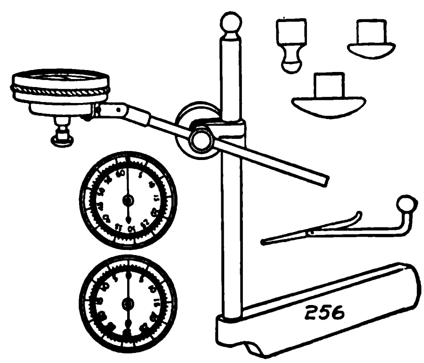
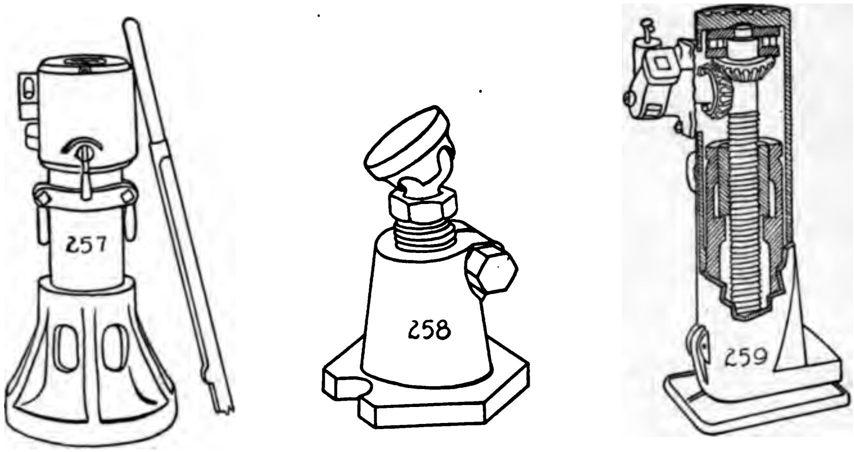
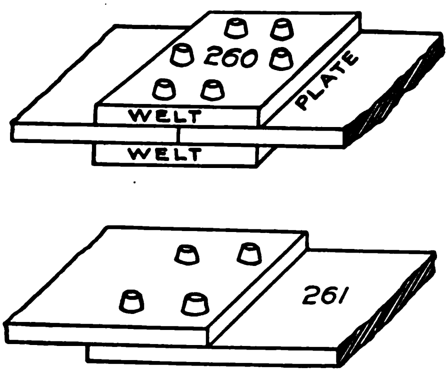


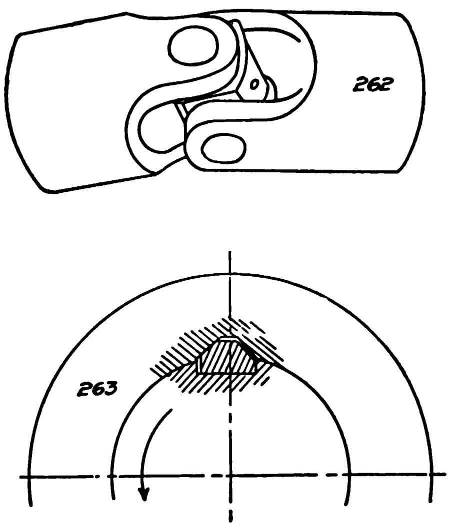
Fig. 256.



Figs. 257–259.

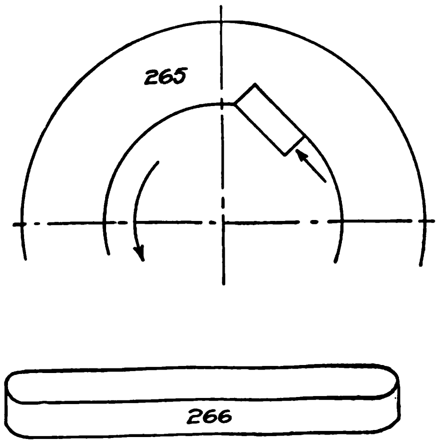


Figs. 260–261.

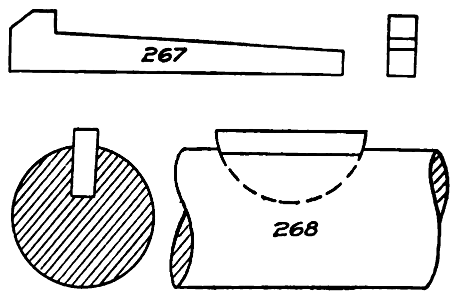


Figs. 262–263.

Fig 264.



Figs. 265–266.



Figs. 267–268.

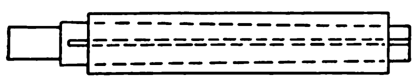


Fig. 269.

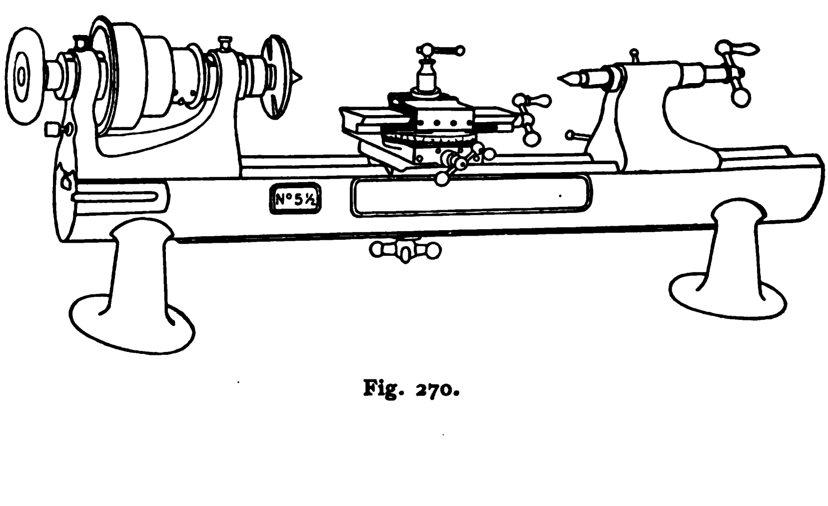


Fig. 270.

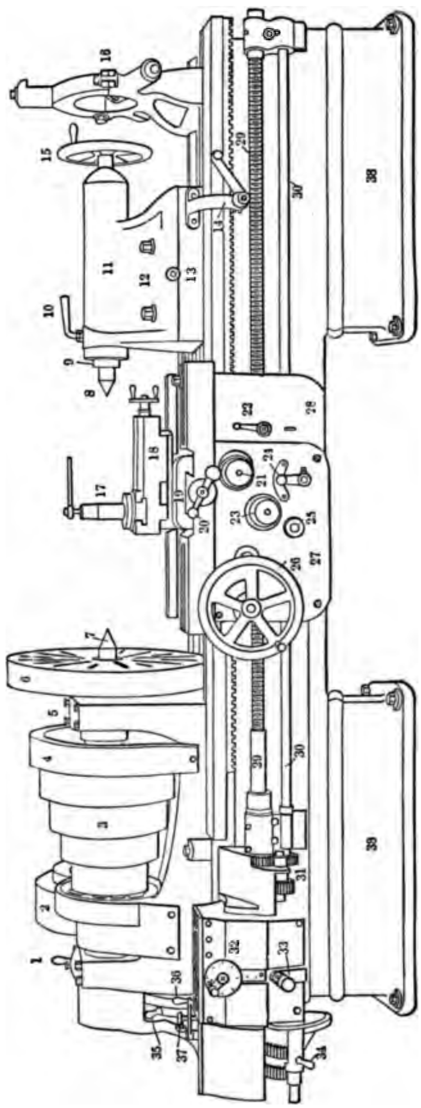


Fig. 271.

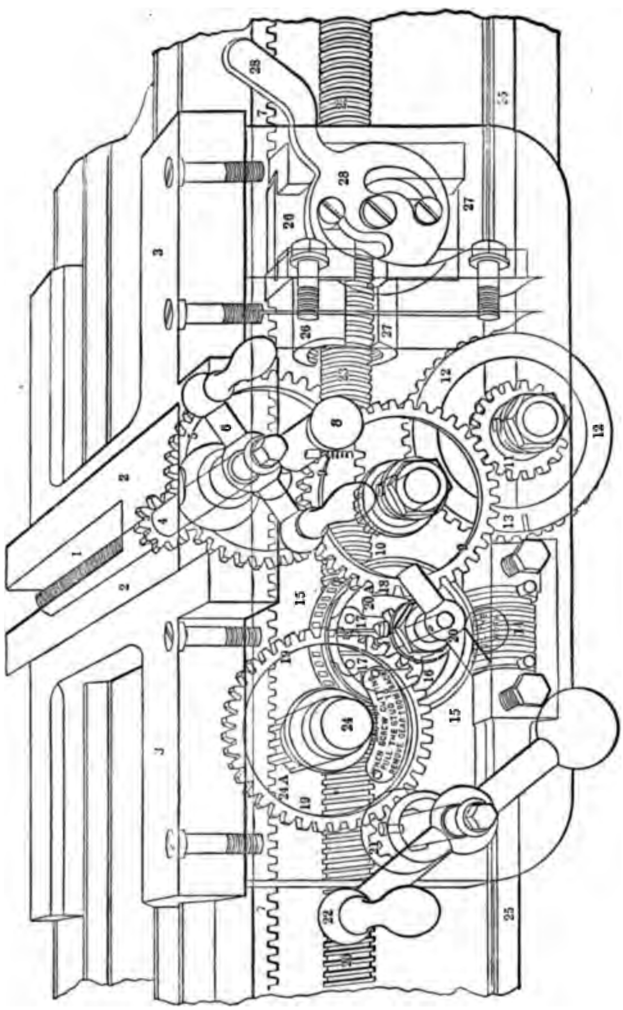


Fig. 271 A.

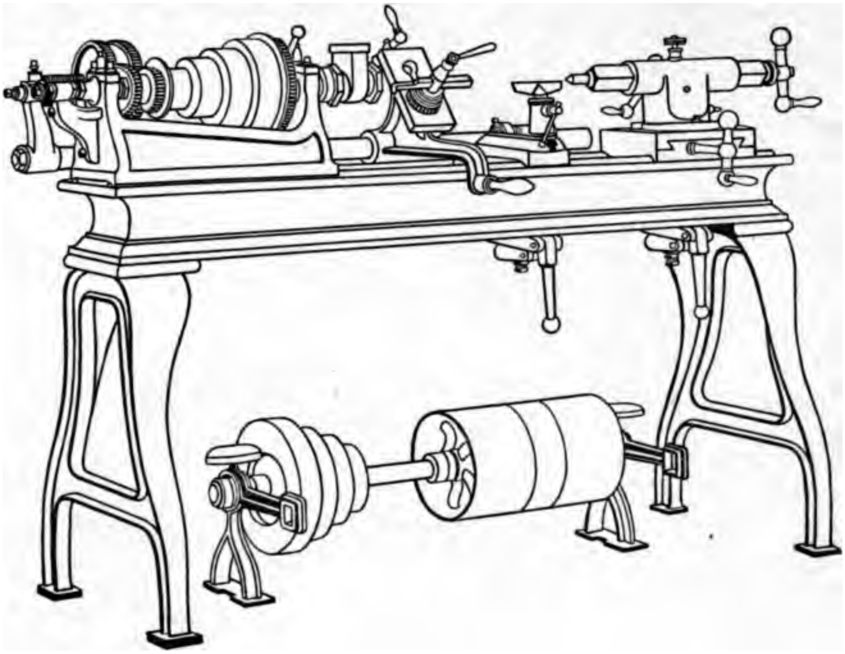


Fig. 272.

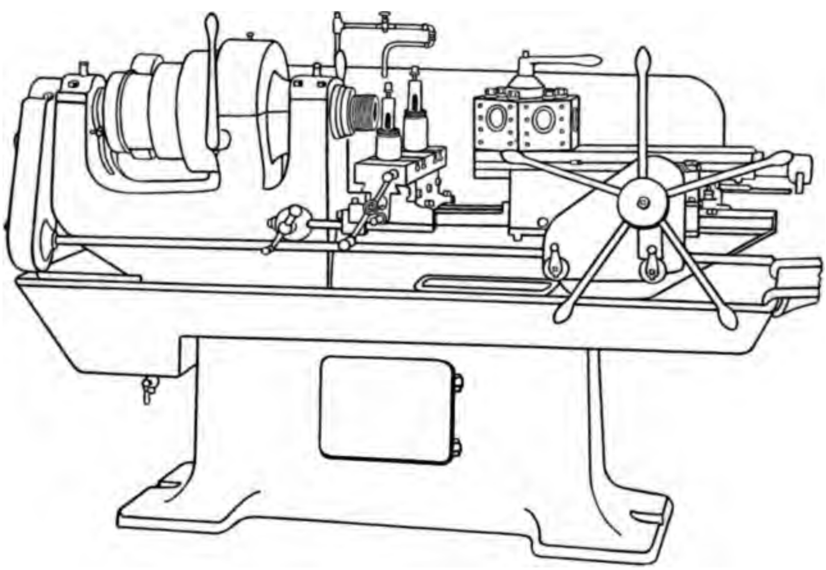


Fig. 273.

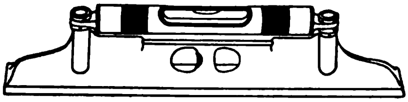


Fig. 274.

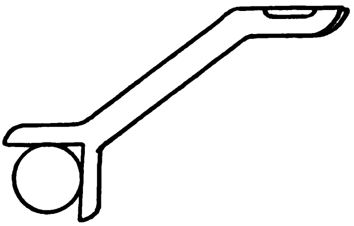
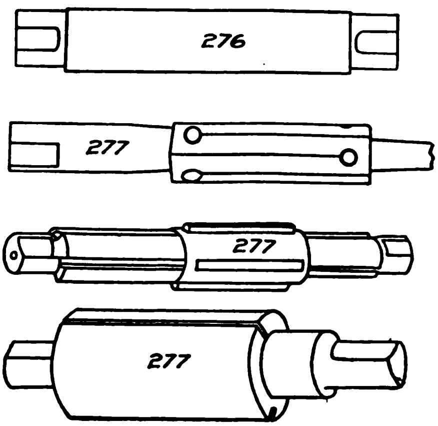


Fig. 275.



Figs. 276–277.

Fig. 279.

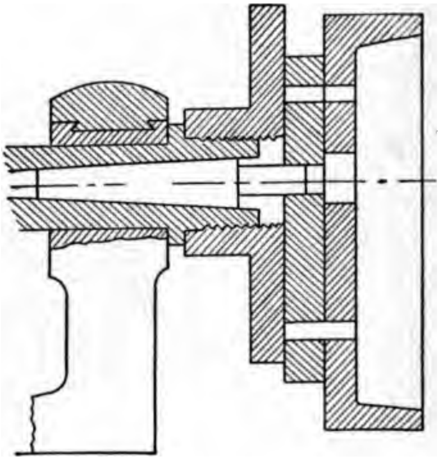
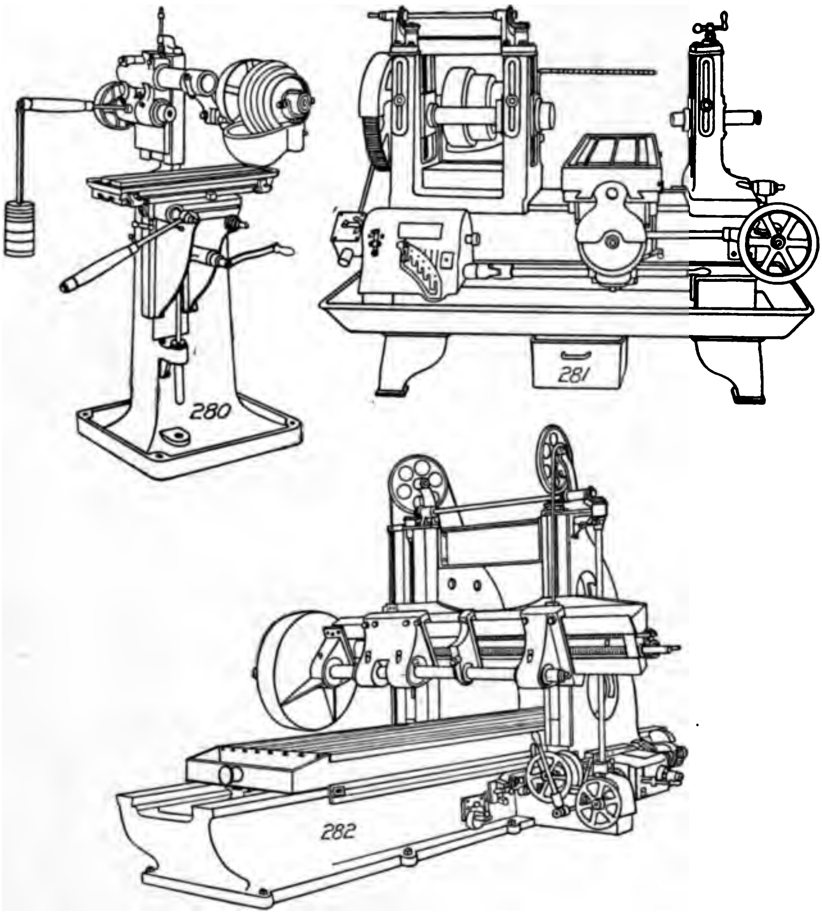


Fig. 278.



Figs. 280–282.

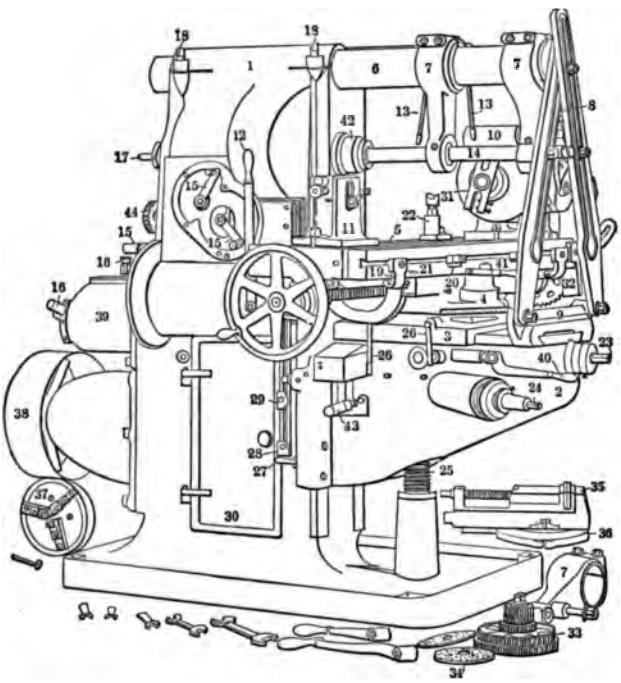

1
2
3
4
5
6
7
7
7
8
9
10
11
12
13
13
14
15
15
15
16
16
17
18
19
19
20
21
22
23
24
25
26
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44

Fig. 283.

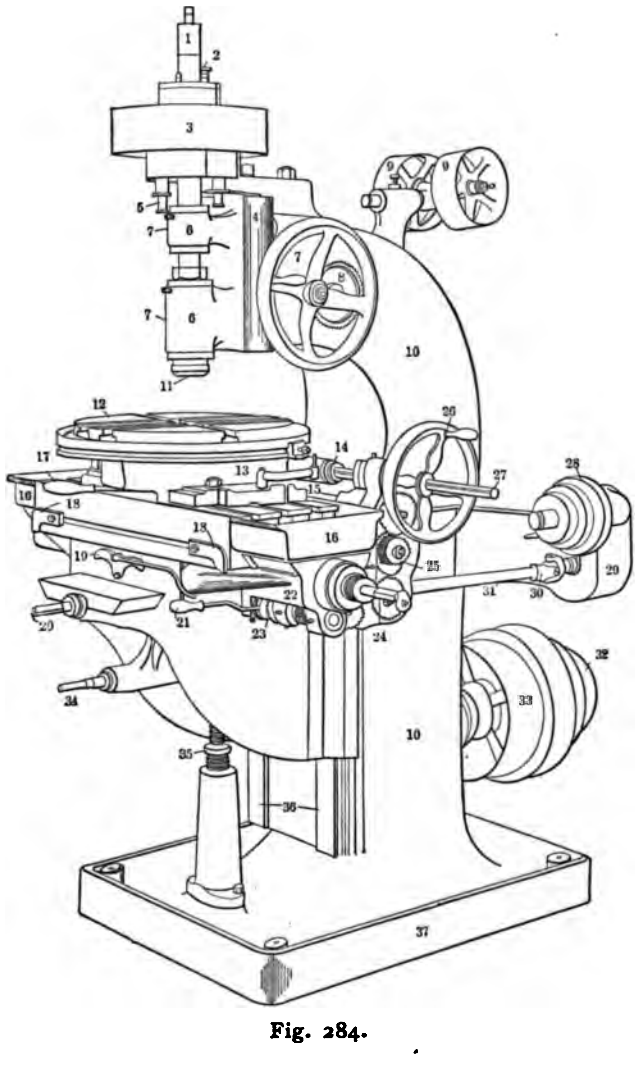

1
2
3
4
5
6
7
8
9
9
7
8
7
6
10
11
12
26
14
13
27
28
17
15
16
18
16
18
19
25
29
22
31
30
20
21
23
24
32
34
33
10
35
36
37

Fig. 284.

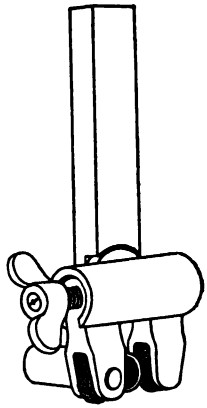
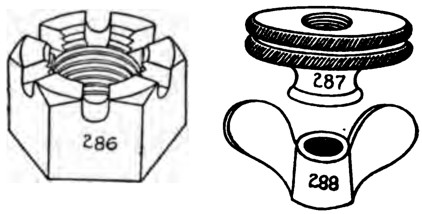


Fig. 285.



Figs. 286–288.

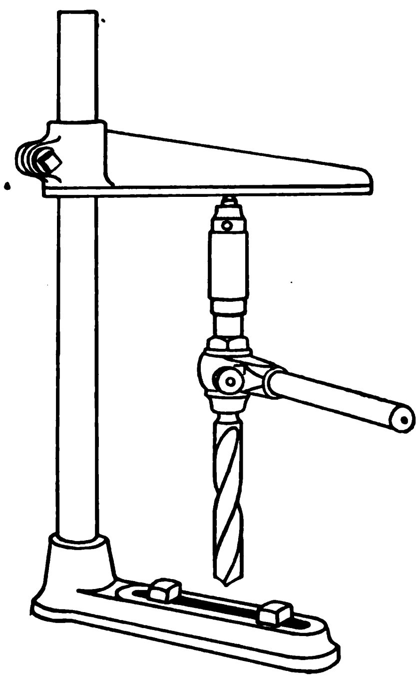
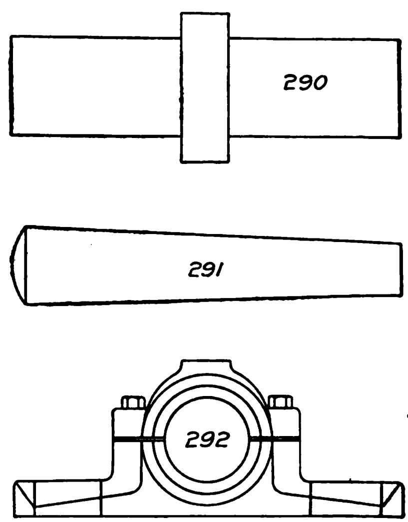


Fig. 289.



Figs. 290–292.

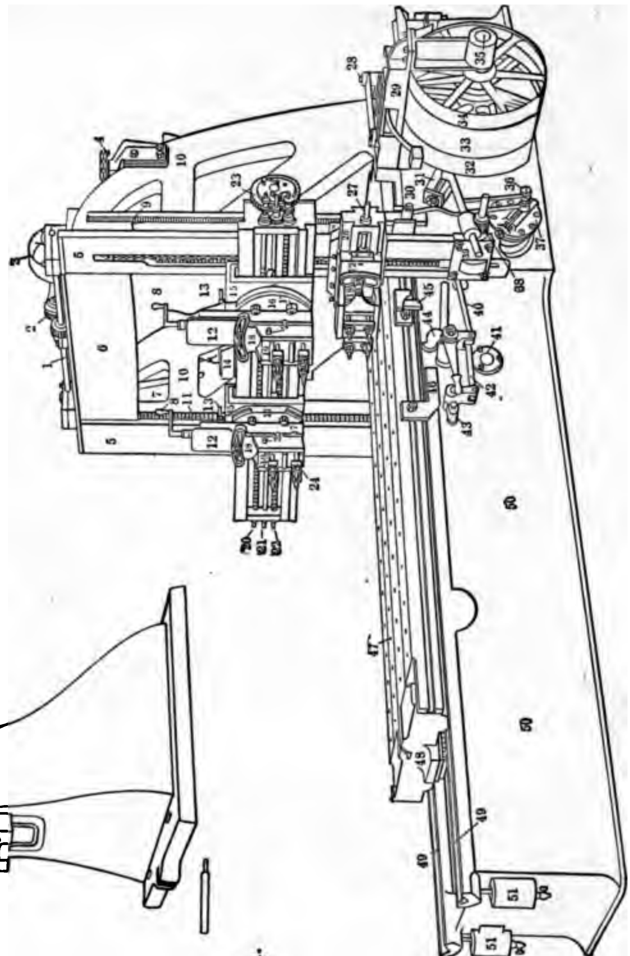


Fig. 293.

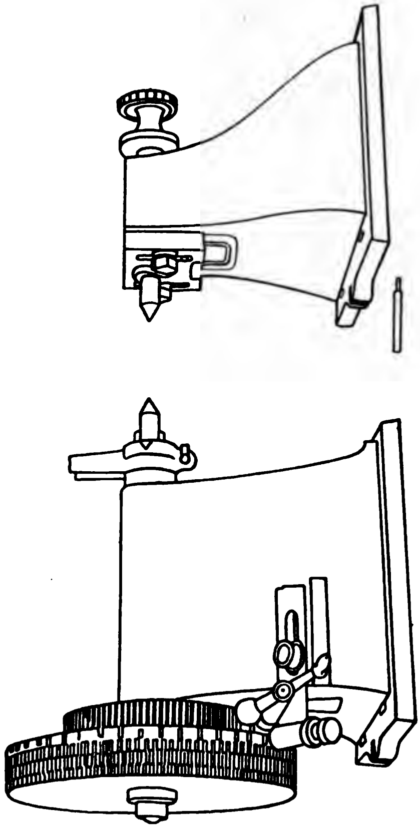
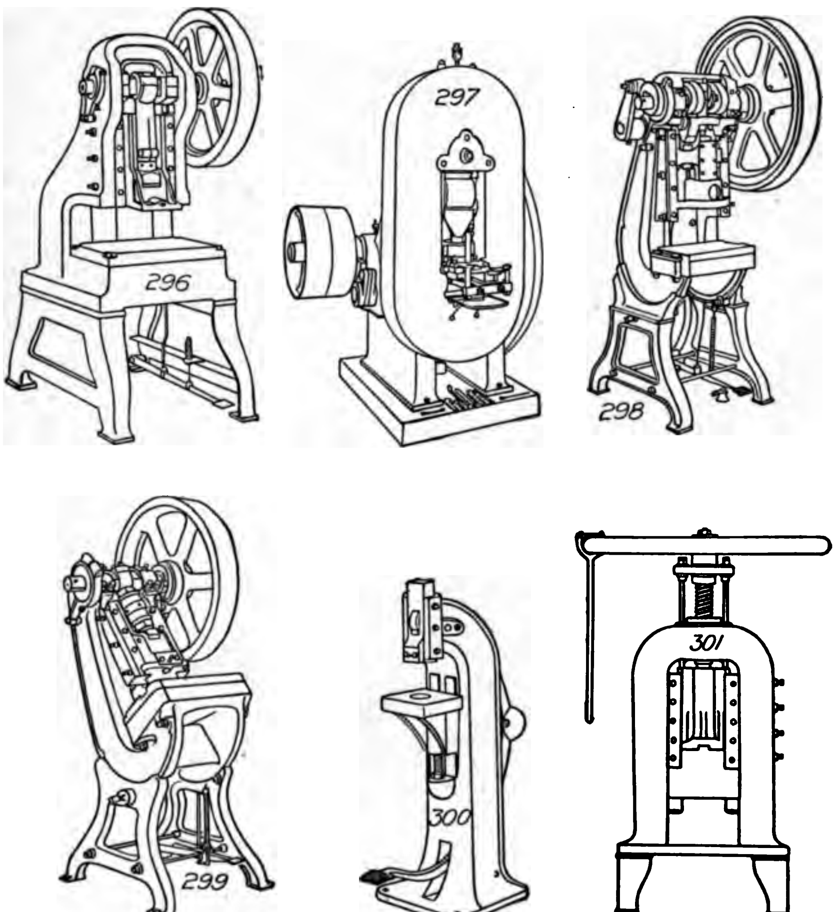


Fig. 294.

Figs. 295.



Figs 296–301.

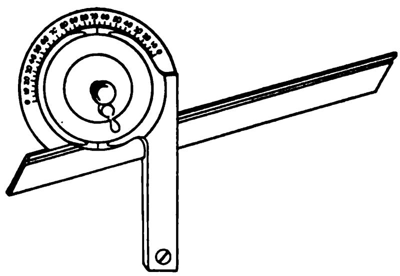


Fig. 302.

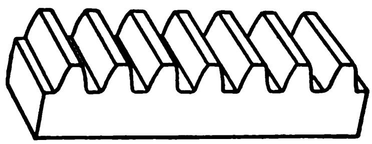


Fig. 303.

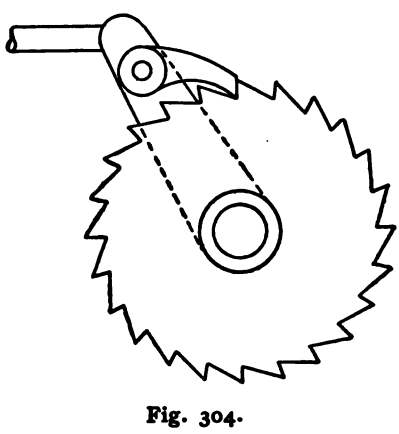
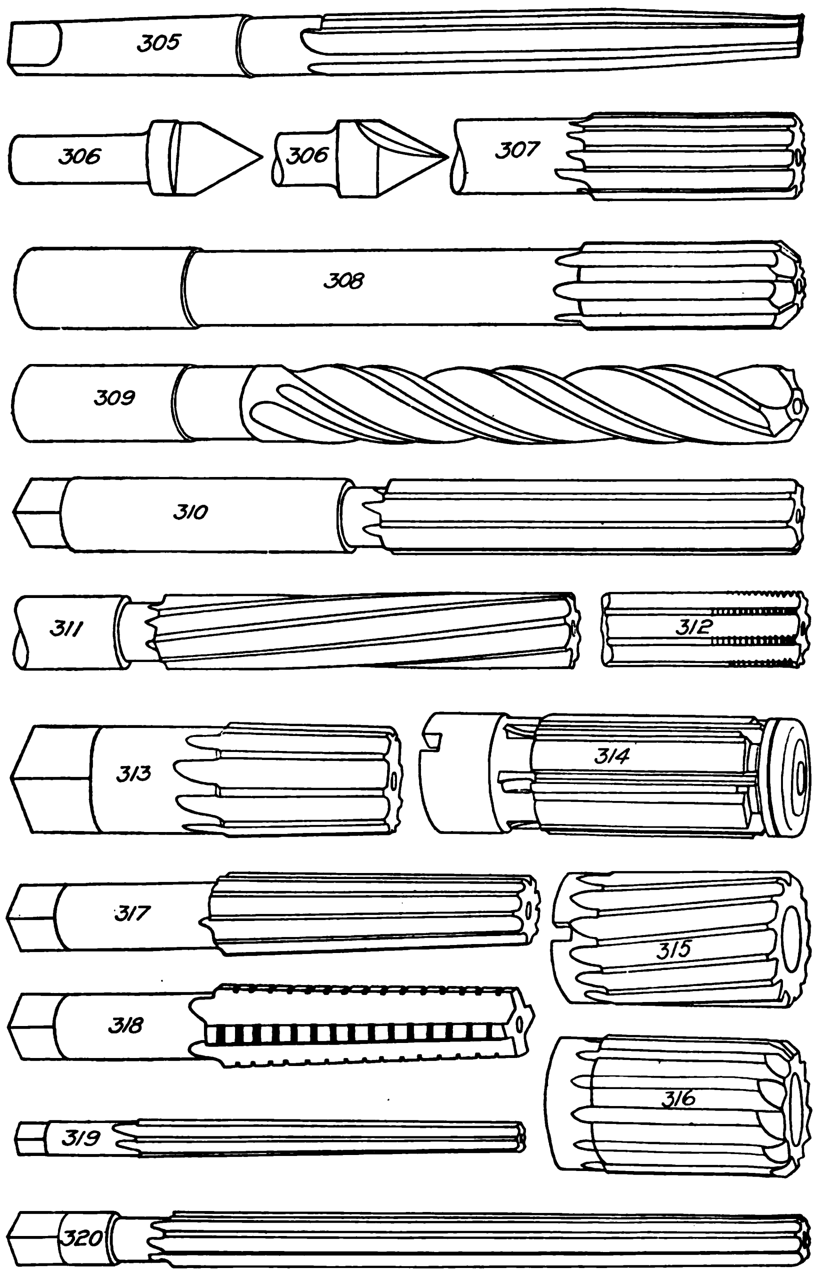
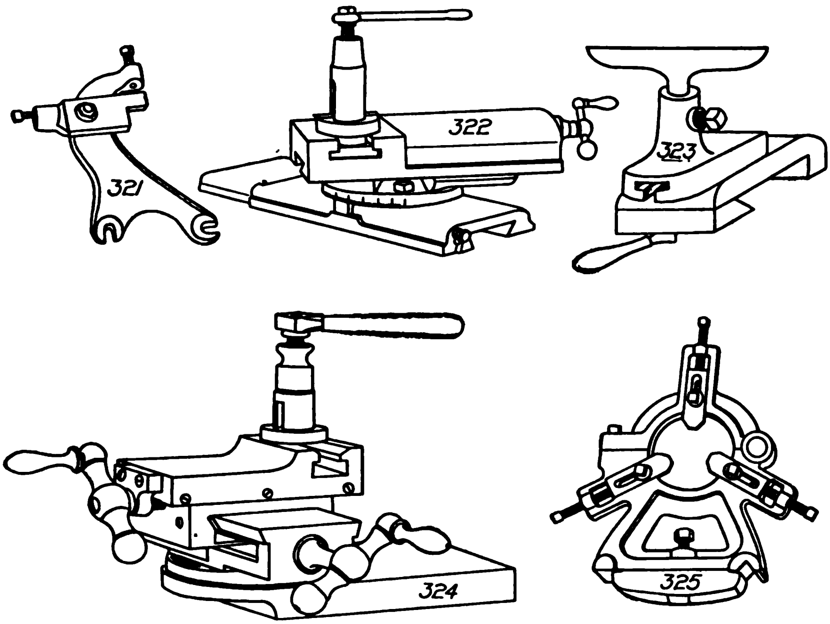


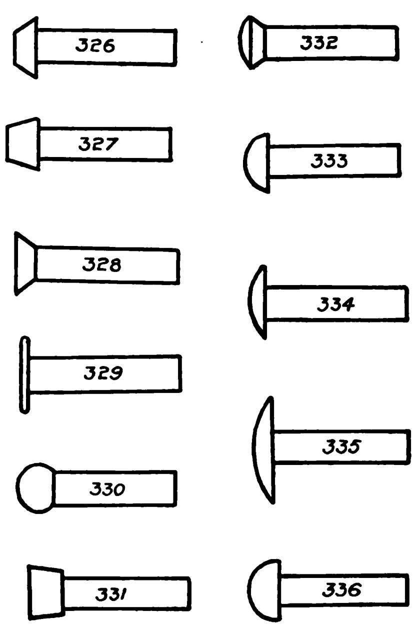
Fig. 304.


305
306
306
307
308
309
310
311
312
313
314
317
315
318
316
319
320

Figs. 305–320.



Figs. 321–325.



Figs. 326–336.

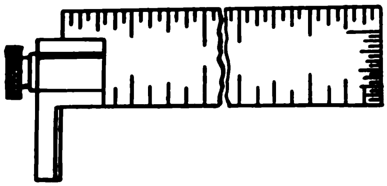
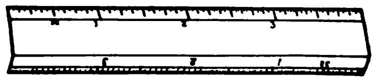


Fig. 337.

Fig. 338.



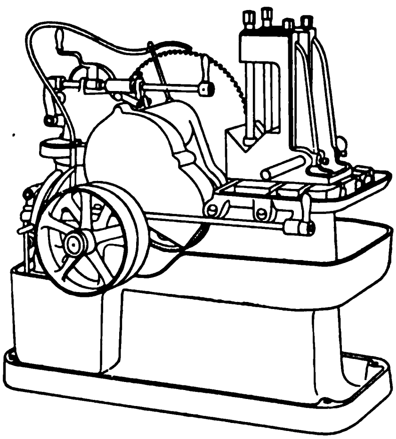
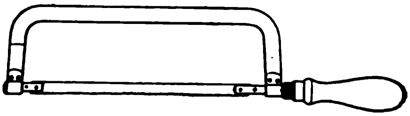


Fig. 339.

Fig. 340.



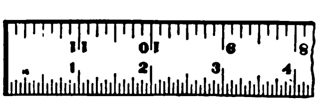
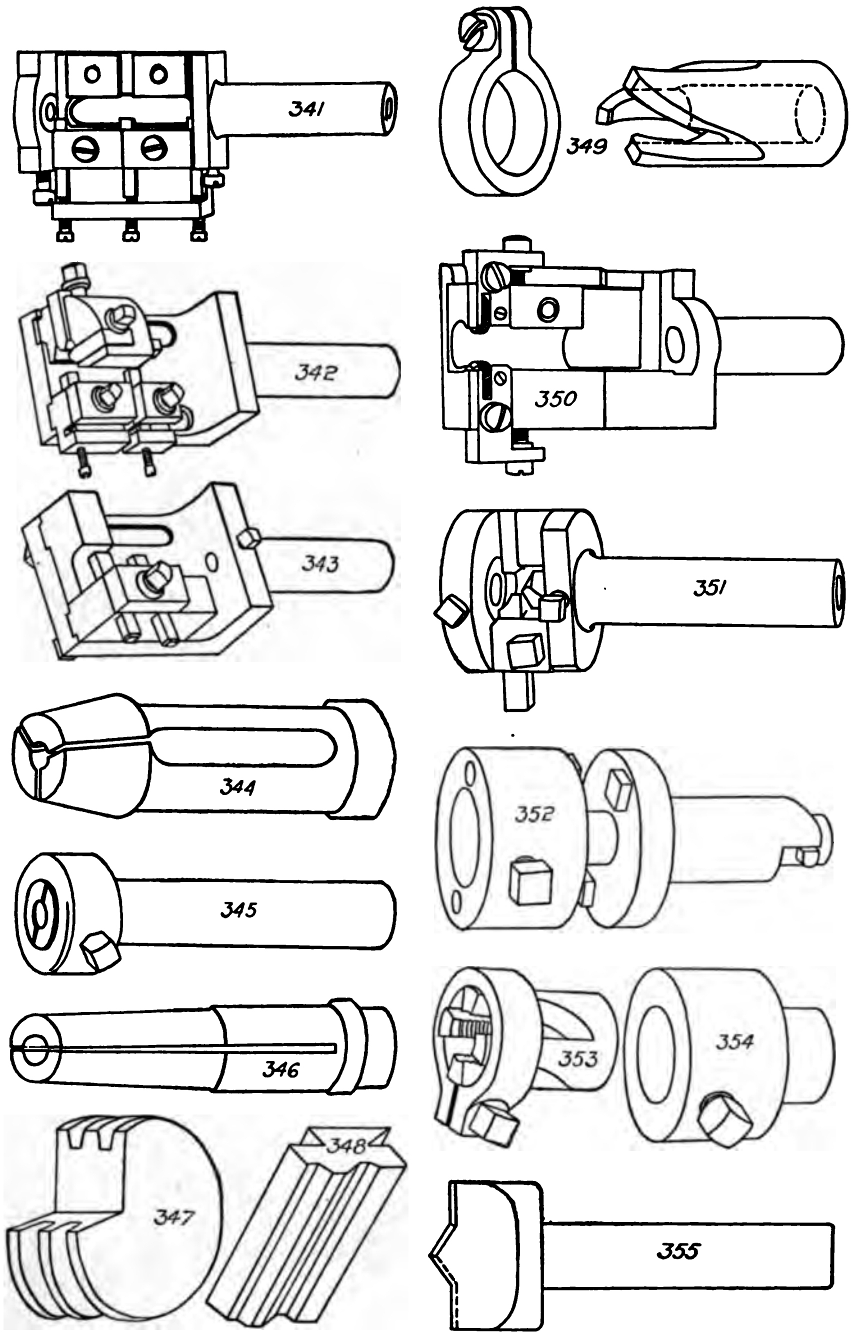
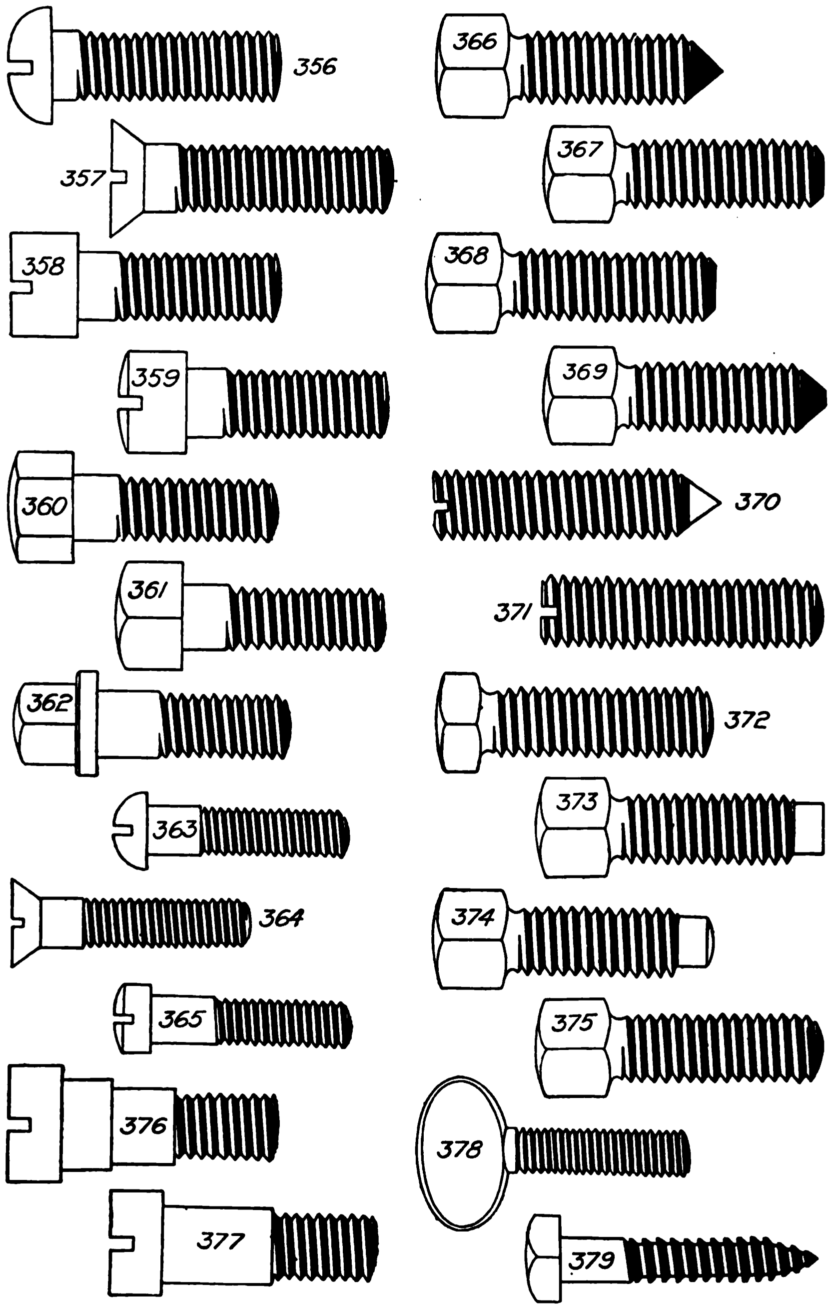


Fig. 340A.



Figs. 341–355.


356
357
358
359
360
361
362
363
364
365
376
377
366
367
368
369
370
371
372
373
374
375
378
379

Figs. 356–379.

Fig. 379A.

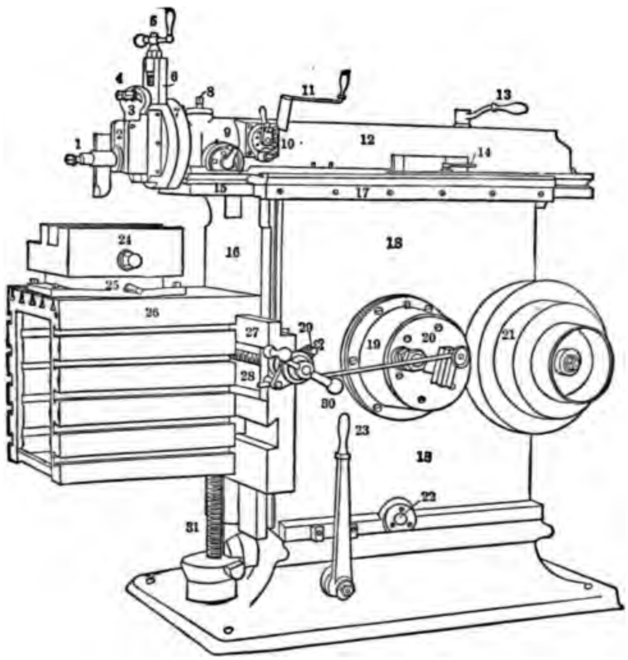
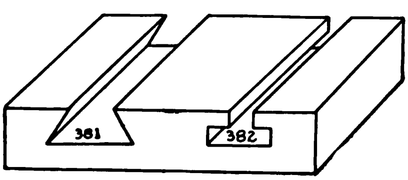


Fig. 380.



Figs. 381–382.

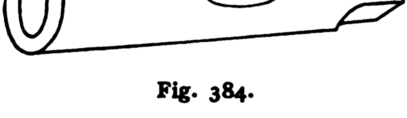


Fig. 384.

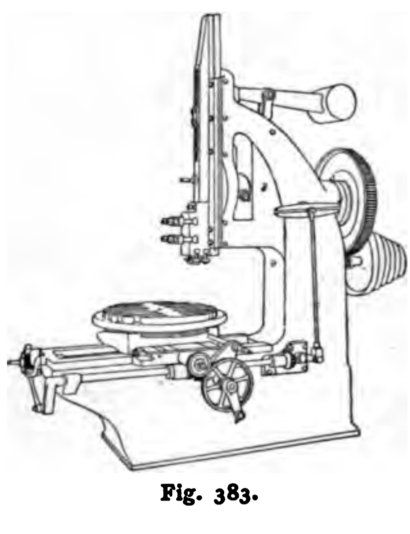


Fig. 383.

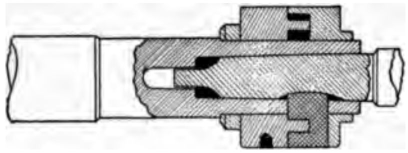


Fig. 385.

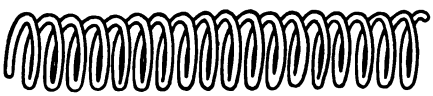


Fig. 386.

Fig. 387.

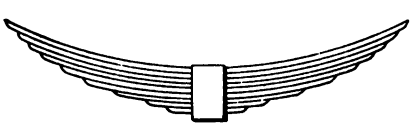
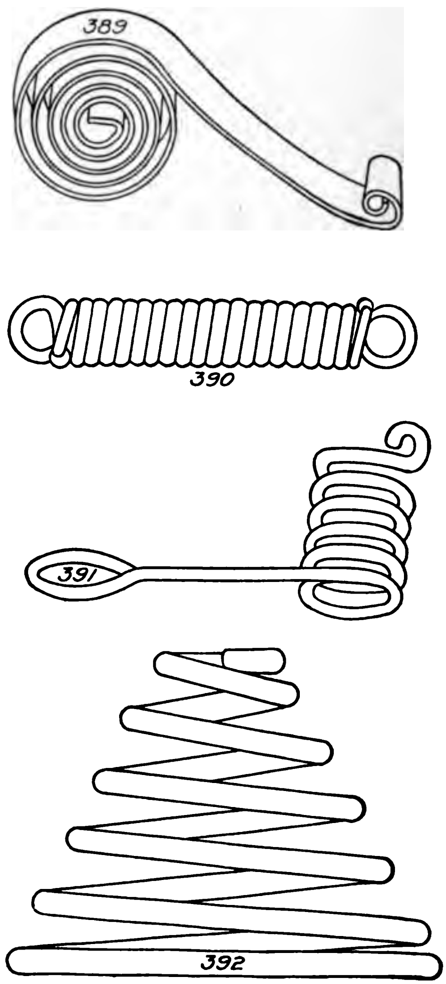
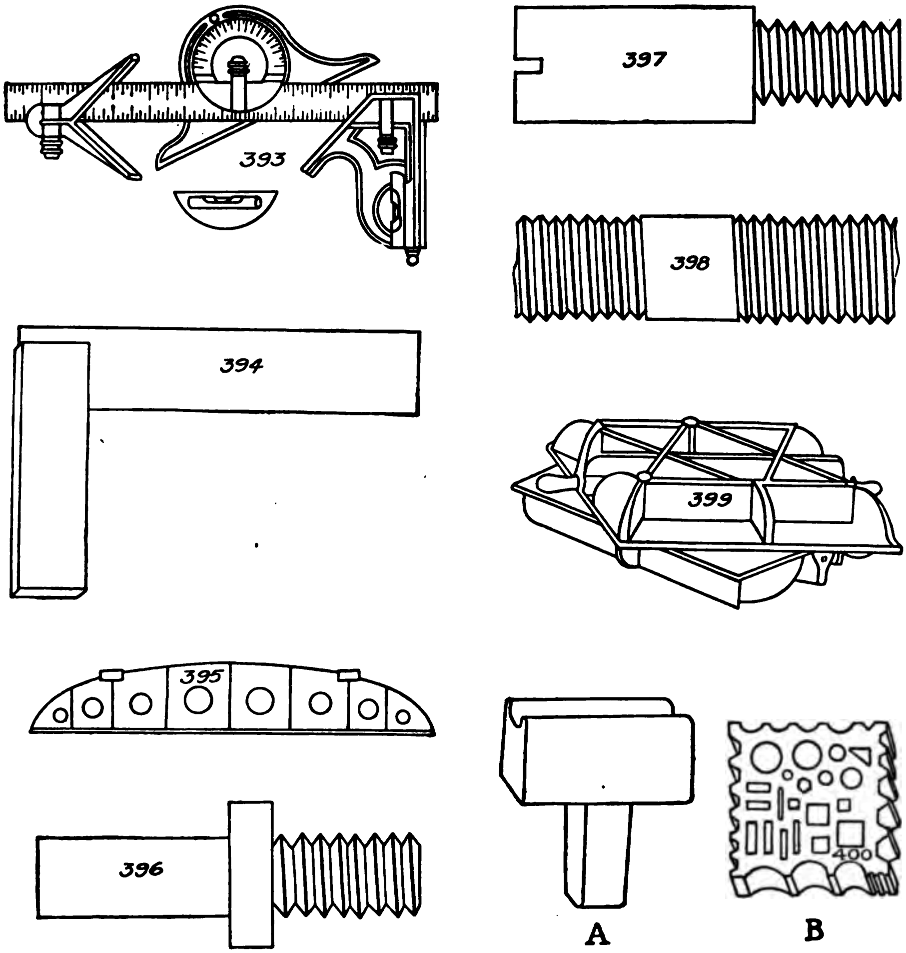


Fig. 388.



Figs. 389–392.



Figs. 393–400.

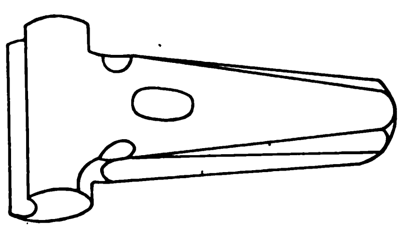
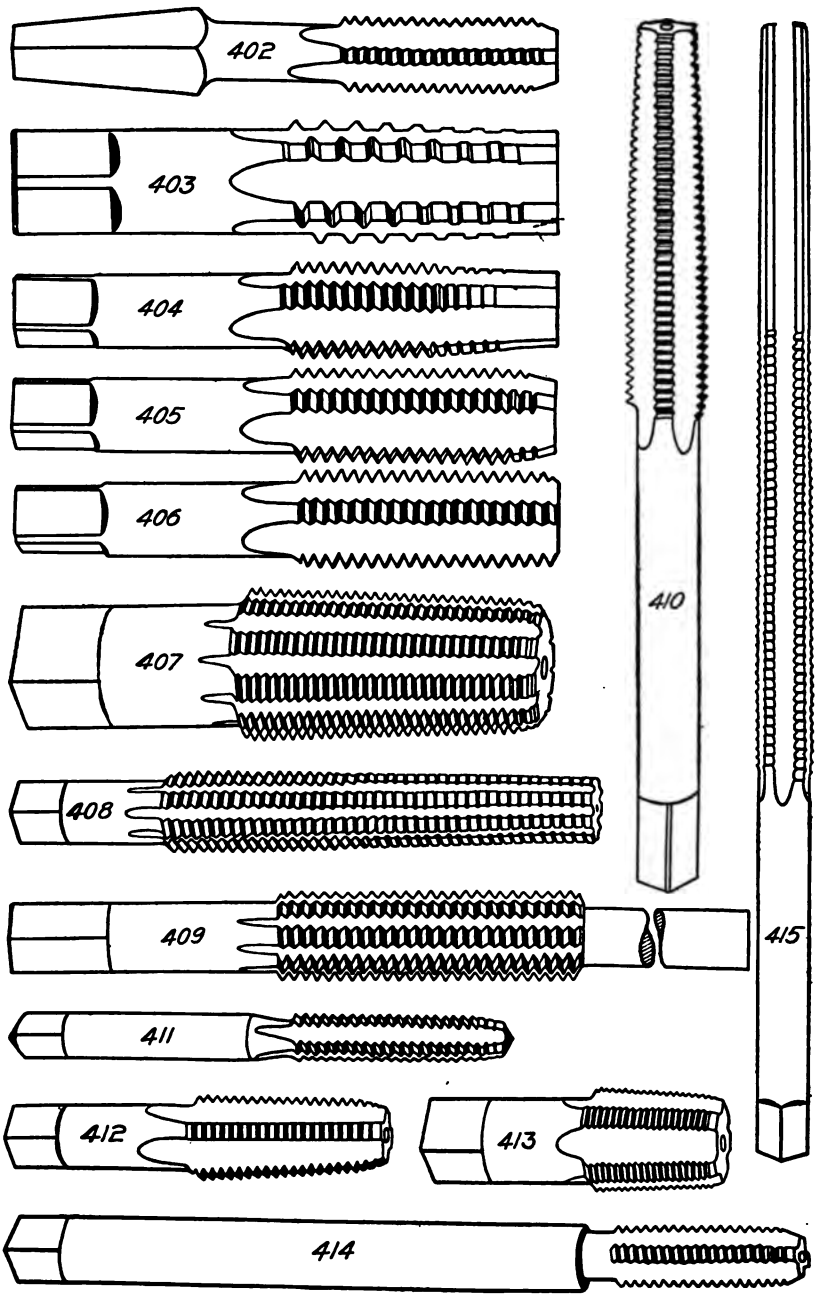
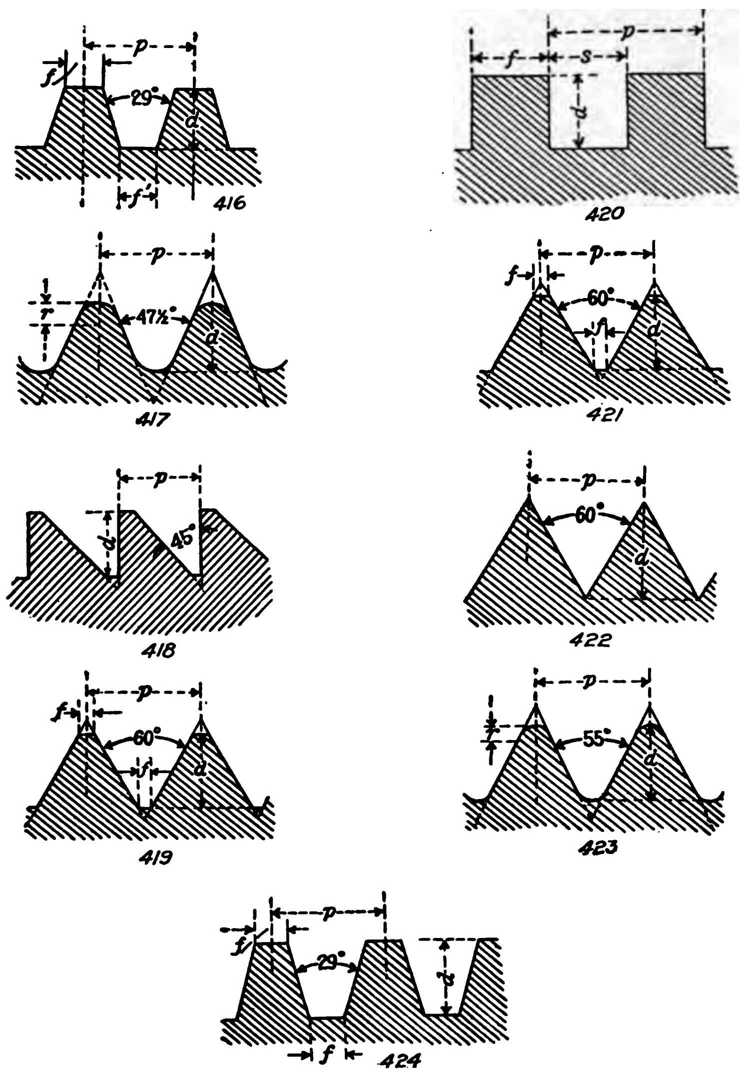


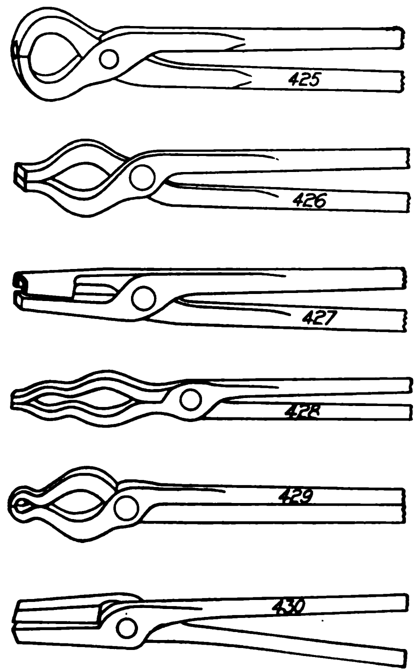
Fig. 401.



Figs. 402–415.



Figs. 416–424.



Figs. 425-430.

Fig. 431 next page.

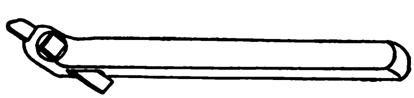


Fig. 432.

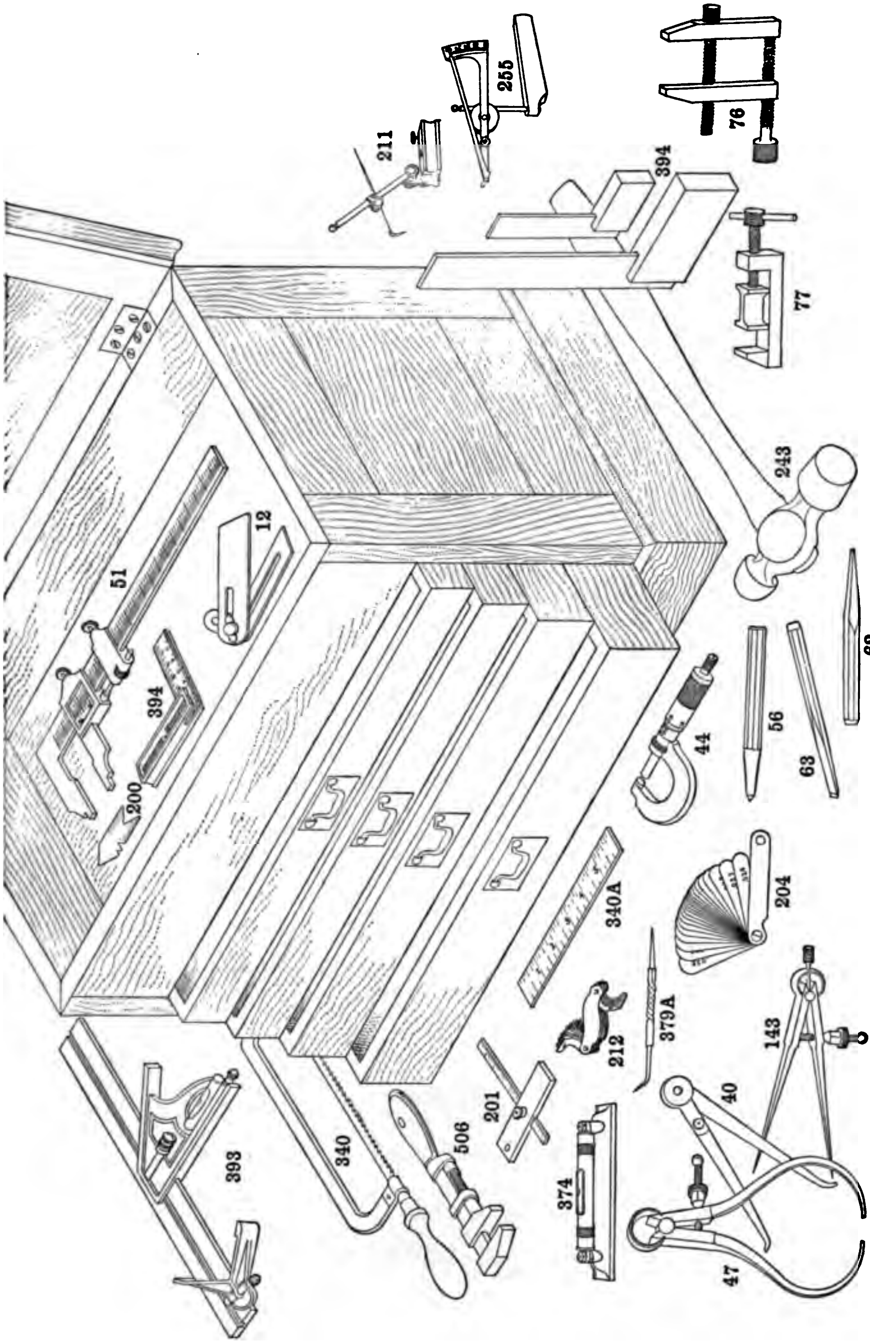
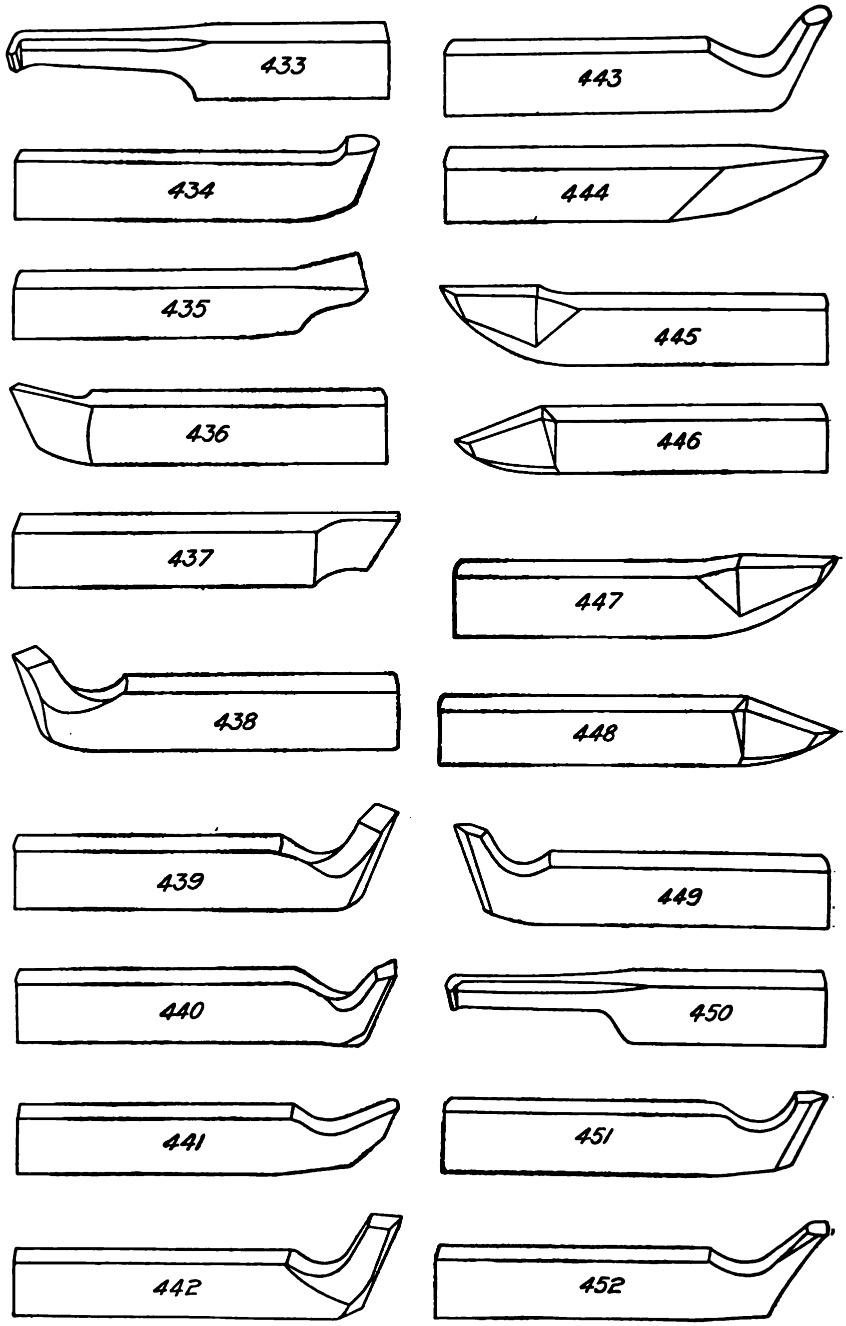
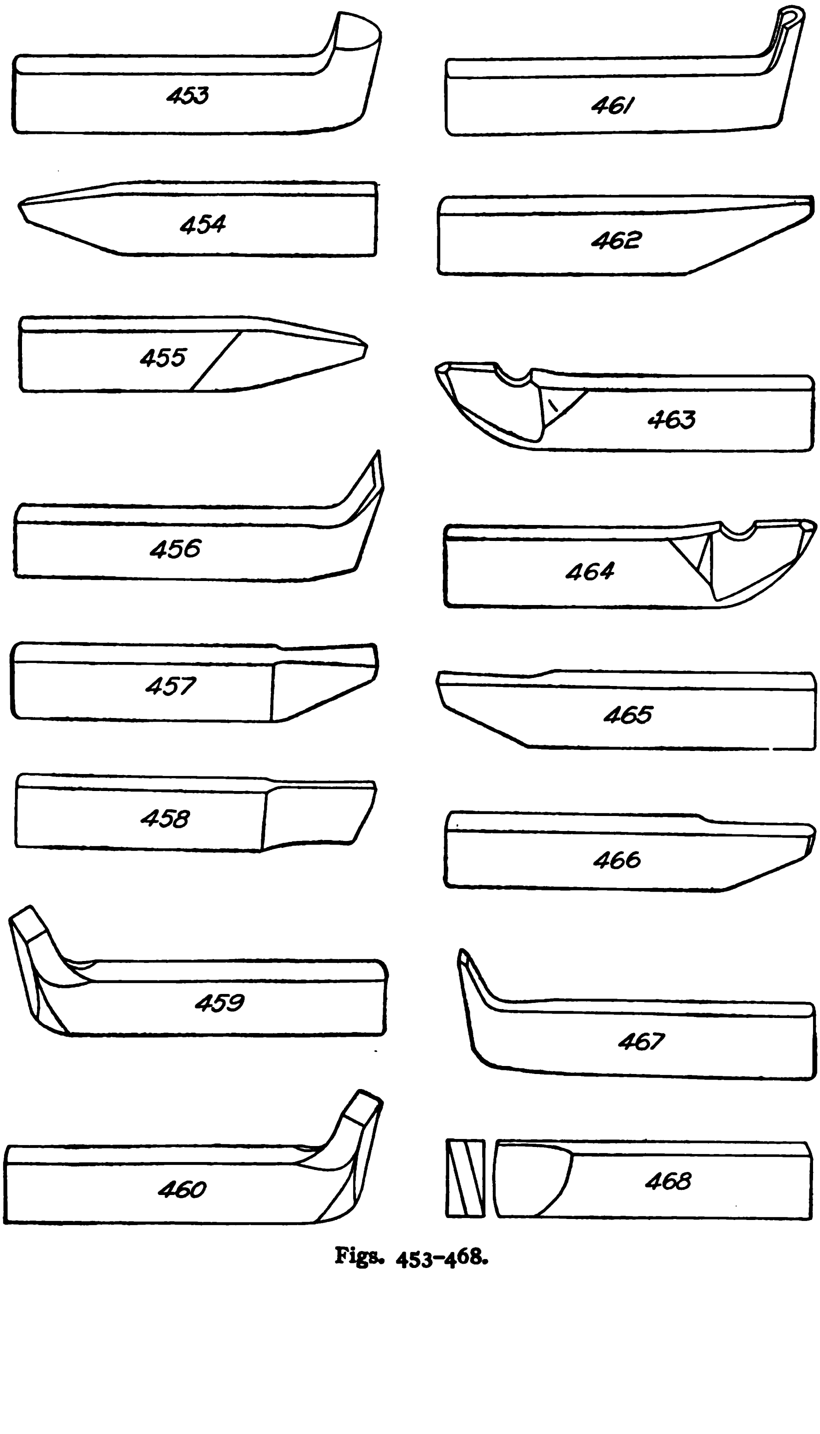

211
255
76
394
77
243
12
51
394
200
44
56
63
62
204
340A
379A
212
143
40
201
506
340
393
374
47

Fig. 431.


433
443
434
444
435
445
436
446
437
447
438
448
439
449
440
450
441
451
442
452

Figs. 433–452.



Figs. 453–468.

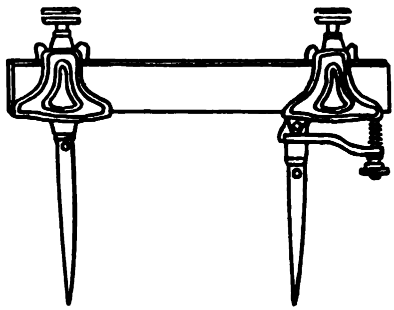


Fig. 469.

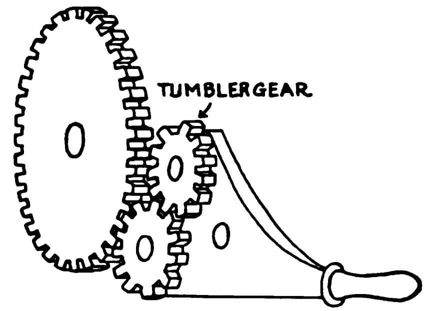


Fig. 470.

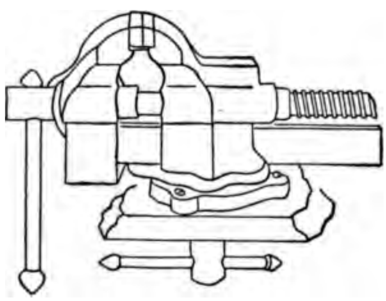


Fig. 471.

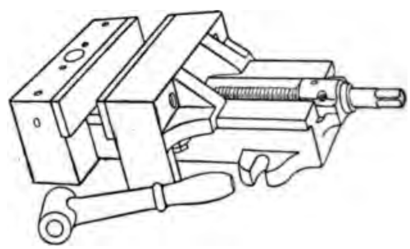


Fig. 472.

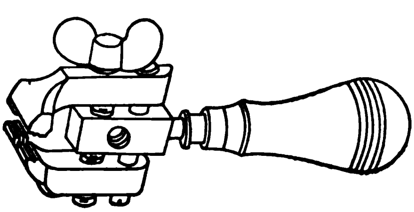


Fig. 473.

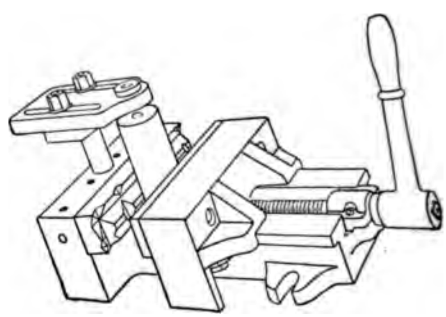


Fig. 474.

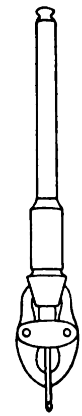


Fig. 475.

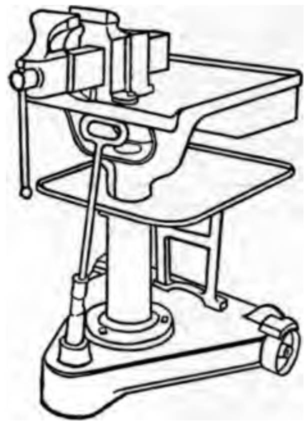


Fig. 476.

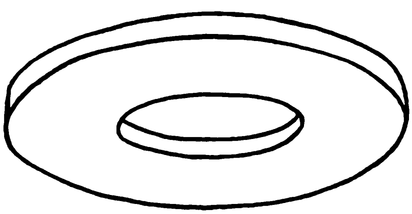


Fig. 477.

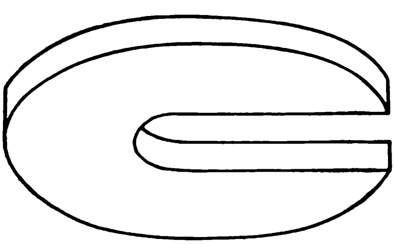
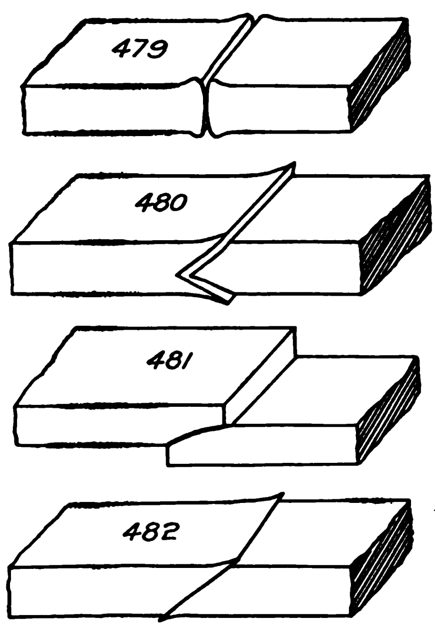
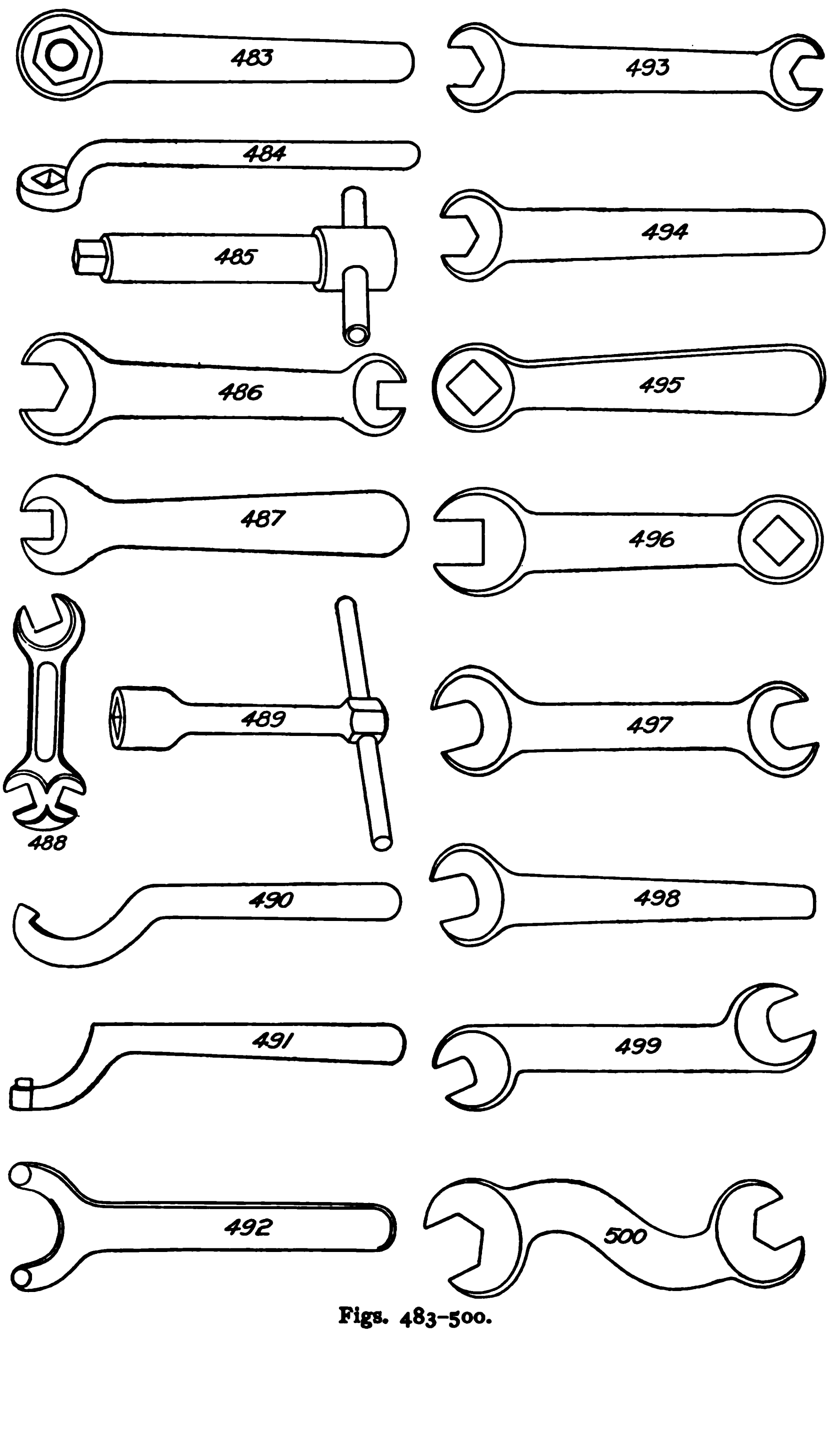


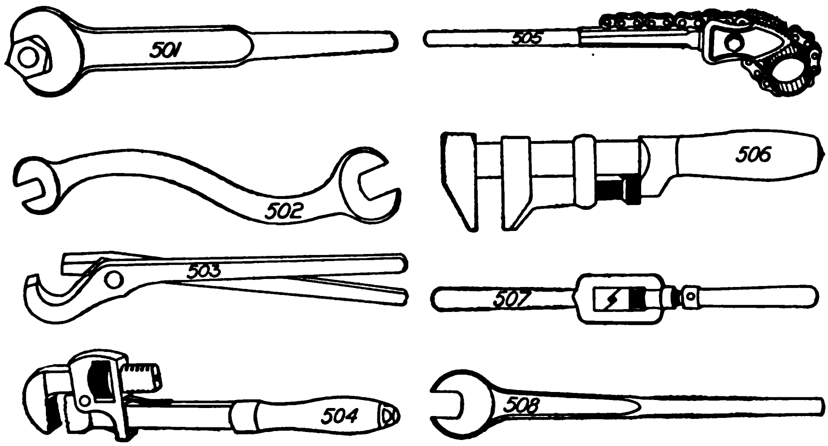
Fig. 478.



Figs. 479–482.


483
493
484
494
485
486
495
487
496
489
488
497
490
498
491
499
492
500

Figs. 483–500.



Figs. 501–508.

SECTION II.

Names of the 508 illustrations in Section I.
For detailed information see Section III.

LIST OF NAMES.

1 Angle Iron
2 Angle Plate
3 Anvil
4 Arbor
5 Balancing Ways
6 Bearing, Ball, Radial
7 Bearing, Ball, Thrust
8 Bearing, Roller, Radial
9 Bearing, Roller, Thrust
10 Belt Fasteners
11 Belt Lacings
12 Bevel
13 Block, Chain
14 Block, Tackle
15 Blow Pipe, Gas
16 Blow Pipe, Plain

BOLTS

17 A. L. A. M. Bolt
18 Boiler Patch Bolt
19 Coupling Bolt
20 Deck Bolt
21 Eye Bolt
22 Hanger Bolt
23 Loom or Carriage Bolt
24 Machine Bolt, Hexagon Head
25 Machine Bolt, Round Head
26 Machine Bolt, Square Head
27 Stove Bolt, Button or Round Head
28 Stove Bolt, Countersunk or Flat Head
29 Tap Bolt, Hexagon Head
30 Tap Bolt, Square Head
31 T Head Planer Bolt
32 Tire Bolt
33 Track Bolt

34 Bolt Cutter
35 Boring and Turning Mill
36 BoringMachine, Horizontal
37 Broach
38 Bunsen Burner
39 Button

CALIPERS

40 Firm Joint Caliper
41 Gear Tooth Caliper
42 Hermaphrodite Caliper
43 Keyhole Caliper
44 Micrometer Caliper
45 Micrometer Caliper Square
46 Odd Leg Caliper
47 Outside Spring Caliper
48 Slide Caliper
49 Thread Caliper
50 Transfer Caliper
51 Vernier Caliper

CAMS

52 Drum or Barrel Cam
53 Edge Cam
54 Face Cam
55 Linear Cam

CENTER PUNCHES
56 Center Punch
57 Center Punch, Automatic
58 Center Punch, Bell or Self-centering
59 Center Punch, Locating

60 Chaser

CHISELS
61 Blacksmiths' Hot Chisel
62 Cape Chisel
63 Cold Chisel
64 Diamond or Lozenge Chisel
65 Round Chisel

CHUCKS
66 Box Chuck
67 Cathead Chuck
68 Draw or Spring Chuck
69 Drill Chuck
70 Lathe Chuck
71 Magnetic Chuck
72 Master or Screw Chuck
73 Planer Chuck, Plain Base
74 Planer Chuck, Swivel Base

CLAMPS
75 "C" Clamp
76 Machinists' Clamp
77 Tool Makers' Clamp

78 Clutch
79 Clutch, Friction
80 Collar
81 Collar, Safety
82 Cotter, Split or Spring
83 Counter, Revolution
84 Counterbore
85 Countershaft

COUPLINGS
86 Clamp Coupling
87 Compression Coupling
88 Flanged Coupling

89 Crane, Jib
90 Crane, Portable
91 Cut Meter
92 Cutter, Flue Sheet

CUTTERS MILLING
93 Angular Cutter
94 Angular Cutter, Concave Side
95 Angular Cutter, Double Angle
96 Concave Cutter
97 Convex Cutter
98 Corner Rounding Cutter, Left Hand
99 Corner Rounding Cutter, Right and Left, Double
100 Corner Rounding Cutter, Right Hand
101 Cotter Mill
102 Dovetail Cutter
103 Dovetail or Bevel Cutter
104 End Mill
105 End Mill with Center Cut
106 Face Cutter
107 Fish Tail Cutter
108 Fluting Cutter for Reamers
109 Fluting Cutter for Spiral Mills
110 Fluting Cutters for Taps
111 Fly Cutter and Arbor
112 Formed Cutter
113 Gang Cutter
114 Gear Cutter
115 Gear Cutter, Duplex

116 Gear Cutter Stocking
117 Hob
118 Inserted Tooth Cutter—Brown & Sharpe
119 Inserted Tooth Cutter—Pratt & Whitney
120 Interlocking Side Cutter
121 Plain Cutter, Narrow
122 Plain Cutter, Wide
123 Rose Cutter
124 Screw Slotting Cutter
125 Shank Cutter
126 Shell End Cutter
127 Side Milling Cutter
128 Slabbing Cutter
129 Slitting Saw
130 Sprocket Wheel Cutter
131 Straight Shank Cutter, Plain
132 Straight Shank Cutter, Taper
133 T Slot Cutter

134 Cutting-off Machine
135 Cutting off Tool Post
136 Diamond Hand Tool
137 Die, Bolt
138 Die Chasers
139 Die, Screw Plate or Stock

DIES, PUNCH PRESS

140 Bending Die
141 Blanking Die
142 Drawing Die

143 Divider, Spring

DOGS

144 Bent Tail Dog
145 Clamp Dog
146 Grinder Dog
147 Straight Tail Dog

DRILLS

148 Center Drill
149 Center Drill, Combination
150 Core Drill
151 Gun Barrel Drill
152 Hollow Drill
153 Oil Drill, Morse
154 Ratchet Drill, Flat
155 Ratchet Drill, Twist
156 Shell Drill
157 Straight Flute Drill
158 Three Groove Drill
159 Twist Drill
160 Twisted Flat Drill

161 Drill, Radial, Universal
162 Drill, Ratchet
163 Drill, Upright
164 Face Plate
165 Face Plate Tapped

FILE CUTS, DOUBLE

166 Bastard
167 Dead Smooth
168 Middle
169 Rough
170 Second Cut
171 Smooth

FILE CUTS, SINGLE

172 Bastard
173 Half Way
174 Middle
175 Rough
176 Second Cut
177 Smooth

FILE SHAPES

178 Barrette
179 Crochet
180 Crossing
181 Extra Narrow Pillar
182 Half Round
183 Hand
184 Knife
185 Metal Saw, Blunt
186 Narrow Pillar
187 Pillar
188 Pippin
189 Rat Tail or Round
190 Slitting
191 Square
192 Three Square or Triangular
193 Warding
194 Files, Dies Sinkers or Riffles
195 Files, Needle

196 Filing Machine
197 Flatter
198 Forge
199 Fullers

GAGES

200 Center Gage
201 Depth Gage
202 Gear Tooth Depth Gage
203 Drill Gage
204 Feeler or Thickness Gage
205 Limit Gage, Female
206 Limit Gage, Male
207 Plug and Ring Gage
208 Radius or Curve Gage
209 Scratch Gage
210 Snap Gage
211 Surface Gage
212 Thread Gage
213 Wire Gage

GEARS

214 Annular Gear
215 Bevel Gear
216 Elliptical Gear
217 Helical Gear
218 Herringbone Gear
219 Intermittent Gear
220 Internal Gear
221 Spiral Gear
222 Sprocket Gear
223 Spur Gear
224 Staggered Tooth Gear
225 Worm Gear
226 Gear Tooth Diagram

227 Gib
228 Gib and Key

GRINDERS

229 Cutter Grinder
230 Cylinder Grinder
231 Disk Grinder
232 Surface Grinder
233 Tool Grinder
234 Universal Grinder
235 Vertical Grinder

GRINDING WHEELS

236 Cup Wheel
237 Cylinder Wheel
238 Disk Wheel
239 Ring Wheel
240 Saucer or Dish Wheel

241 Grinding Wheel Dresser
242 Guide Liner

HAMMERS, MACHINISTS

243 Ball Peen Hammer
244 Cross Peen Hammer
245 Engineers' Hammer
246 Riveting Hammer
247 Straight Peen Hammer

HAMMERS, POWER

248 Drop Hammer
249 Helve Hammer
250 Spring Hammer
251 Steam Hammer

252 Hanger, Drop
253 Hanger, Post
254 Hardie
255 Indicator, Plain
256 Indicator, Watch Dial

JACKS

257 Hydraulic Jack
258 Leveling Jack
259 Screw Jack

JOINTS

260 Butt Joint
261 Lap Joint
262 Universal Joint

KEYS

263 Barth Key
264 Center Key
265 Lewis Key
266 Round End Key
267 Taper Key
268 Woodruff Key

269 Lap

LATHES

270 Bench or Precision Lathe
271 Engine Lathe
271A Engine Lathe Apron
272 Fox Lathe
273 Turret Lathe

274 Level
275 Level, Quartering
276 Mandrel
277 Mandrel, Expanding
278 Master Plate
279 Measuring Rod, End

MILLING MACHINES

280 Hand Milling Machine
281 Lincoln Milling Machine
282 Planer or Slab Milling Machine
283 Universal Milling Machine
284 Vertical Milling Machine

285 Nurling Tool

NUTS

286 Castle or Castellated Nuts
287 Thumb Nut
288 Wing Nut

289 Old Man
290 Pin, Collar
291 Pin, Taper
292 Pillow Block
293 Planer
294 Planer Centers
295 Plumb Bob, Mercury

PRESSES

296 Blanking Press
297 Coining Press
298 Double Action Press
299 Inclinable Press

300 Pendulum Press
301 Screw Press

302 Protractor, Bevel
303 Rack
304 Ratchet and Pawl

REAMERS

305 Bridge Reamer
306 Center Reamer
307 Chucking Reamer, Fluted
308 Chucking Reamer, Rose
309 Chucking Reamer, Three Groove
310 Hand Reamer, Regular or Straight Flute
311 Hand Reamer, Spiral Flute
312 Hand Reamer, Threaded End
313 Pipe Reamer
314 Shell Reamer, Adjustable
315 Shell Reamer, Regular Spiral Flute
316 Shell Reamer, Rose
317 Taper Reamer, Finishing
318 Taper Reamer, Roughing
319 Taper Reamer for Standard Pins
320 Taper Reamer, Locomotive

RESTS

321 Back or Follow Rest
322 Compound Rest
323 Hand Rest
324 Slide Rest
325 Steady Rest

RIVETS

326 Bevel Head Rivet
327 Cone Head Rivet
328 Countersunk Head Rivet
329 Flat Head Rivet
330 Globe Head Rivet
331 Machine Head Rivet
332 Oval Countersunk Head Rivet
333 Round Head Rivet
334 Truss Head Rivet
335 Wagon Box Head Rivet
336 Wheel Head Rivet

337 Rule, Hook
338 Rule, Keyseat
339 Saw, Cold
340 Saw, Hack
340A Scale

SCREW MACHINE TOOLS

341 Box Tool, Bushing
342 Box Tool, Finishing
343 Box Tool, Roughing
344 Collet or Chuck
345 Drill Holder
346 Feed Finger or Tube
347 Forming Tool, Circular
348 Forming Tool, Dovetail
349 Hollow Mill and Clamp Ring
350 Nurling Tool
351 Pointing Tool
352 Revolving Die Holder
353 Spring Die and Clamp Ring
354 Spring Die Extension
355 Squaring and Spotting Tool

SCREWS

356 Cap Screw, Button Head

357 Cap Screw, Countersunk Head
358 Cap Screw, Filister Head, Flat
359 Cap Screw, Filister Head, Oval
360 Cap Screw, Hexagon Head
361 Cap Screw, Square Head
362 Collar Screw
363 Machine Screw, Button or Round Head
364 Machine Screw, Countersunk or Flat Head
365 Machine Screw, Filister Head
366 Set Screw, Cone Point
367 Set Screw, Cup Point
368 Set Screw, Flat Point
369 Set Screw, Hanger Point
370 Set Screw, Headless, Cone Point
371 Set Screw, Headless, Round Point
372 Set Screw, Low Head
373 Set Screw, Pivot Point, Flat
374 Set Screw, Pivot Point, Round
375 Set Screw, Round Point
376 Shoulder Screw, Double
377 Shoulder Screw, Single
378 Thumb or Wing Screw
379 Wood Screw, Lag

379A Scriber
380 Shaper
381 Slot, Dovetail
382 Slot, "T"
383 Slotter
384 Socket
385 Socket, Grip

SPRINGS

386 Compression Spring
387 Flat Spring
388 Leaf Spring
389 Spiral Spring
390 Tension Spring
391 Torsion Spring
392 Valve Spring

393 Square, Combination
394 Square, Try
395 Straight Edge

STUDS

396 Collar Stud
397 Shoulder Stud
398 Threaded Stud or Stud Bolt
399 Surface Plate
400 Swaging Blocks
401 Swaging Hammer

TAPS

402 Bit Brace Tap
403 Echols' Thread Tap
404 Hand Tap, First or Taper
405 Hand Tap, Second or Plug
406 Hand Tap, Third or Bottoming
407 Hob Tap for Pipe Dies
408 Hob Tap for Solid Dies
409 Hob Tap, Sellers'
410 Machine or Nut Tap
411 Machine Screw Tap
412 Patch Bolt Tap
413 Pipe Tap
414 Pulley Tap
415 Stay Bolt Tap

THREADS, SCREW

416 Acme Thread
417 British Standard Thread
418 Buttress Thread
419 International (Metric) Standard Thread
420 Square Thread
421 United States Standard Thread
422 V Thread
423 Whitworth Standard Thread
424 Worm Thread, Brown and Sharpe

TONGS

425 Bolt Tongs
426 Gad Tongs
427 Lathe Tool Tongs
428 Pick-up Tongs, Double
429 Rivet Tongs
430 Straight Lipped Tongs

431 Tool Box or Chest
432 Tool Holder, Lathe or Planer

TOOLS, LATHE

433 Boring Tool, Inside
434 Bull Nose Tool
435 Center Truing Tool
436 Cutting-off Tool, Bent
437 Cutting-off Tool, Straight
438 Diamond Point, Left Hand
439 Diamond Point, Right Hand
440 Diamond Point, Right Hand, Bent
441 Finishing or Necking Tool
442 Half Diamond Point, Right Hand
443 Round Nose Tool
444 Scaling Tool
445 Side Tool, Left Hand
446 Side Tool, Left Hand, Bent
447 Side Tool, Right Hand
448 Side Tool, Right Hand, Bent
449 Threading Tool, Bent
450 Threading Tool, Inside
451 Threading Tool, Straight
452 Water Polishing Tool

TOOLS, PLANER

453 Bull Nose Tool
454 Bevel Tool, Left Hand
455 Bevel Tool, Right Hand
456 Broad Nose or Stocking Tool
457 Corner Finishing Tool
458 Cutting-off Tool
459 Diamond Point Tool, Left Hand
460 Diamond Point Tool, Right Hand
461 Gouge Nose Tool
462 Scaling Tool
463 Side Tool, Left Hand
464 Side Tool, Right Hand
465 Siding Tool, Left Hand
466 Siding Tool, Right Hand
467 Smoothing Tool For Cast Iron
468 Smoothing Tool for Wrought Iron

469 Trammels
470 Tumbler Gear

VISES

471 Bench Vise

472 Drill Vise
473 Hand Vise
474 Jig Vise
475 Pin Vise
476 Vise Stand

477 Washer
478 Washer, "C," Open or Horseshoe

WELDS

479 Butt Weld
480 Crotch Weld
481 Lap Weld
482 Scarf Weld

WRENCHES

483 Box Wrench
484 Chuck Wrench
485 Key Wrench
486 Set Screw Wrench, Double End
487 Set Screw Wrench, Single End
488 Set Screw Wrench, Triple End
489 Socket Wrench
490 Spanner Wrench, Hook
491 Spanner Wrench, Pin
492 Spanner Wrench, Pin Face
493 Straight Wrench, Hexagon, Double End
494 Straight Wrench, Hexagon, Single End
495 Tool Post Wrench, Box
496 Tool Post Wrench, Double End
497 15-Degree Angle Wrench, Double End
498 15-Degree Angle Wrench, Single End
499 22 1/2-Degree Angle Wrench
500 22 1/2-Degree Angle, Double "S" Wrench

MISCELLANEOUS WRENCHES

501 Construction Wrench
502 General Service Wrench
503 Pipe Tong Wrench
504 Pipe Wrench, Stillson
505 Pipe Wrench, Vulcan Chain
506 Screw or Monkey Wrench
507 Tap Wrench
508 Track Wrench

SECTION III.

An alphabetical reference to general information about shop matters. All those illustrated in Section I have a corresponding number to their respective references in this section.

DICTIONARY OF SHOP TERMS.

A

Ampere—The unit of electric current. The amount of current which one volt can force through a resistance of one ohm.

Ampere Hour—One ampere flowing for one hour.

Ampere Turns—A term used in electro-magnet work to represent the amount of magnetism. It is the number of turns of wire multiplied by the number of amperes.

Angle Iron—(Fig. 1). The name usually applied to rolled iron or steel shapes having two legs at right angles to each other. Also applied to cast-iron angle pieces used to hold work, but these are generally called angle plates.

Angle Plate—(Fig. 2). A casting having two surfaces, usually but not always at right angles to each other. One side is bolted to a face plate or machine table while the other side holds the work to be done.

Annealing—The softening of steel, rolled brass, copper or castings by heating to a comparatively low heat and allowing to cool gradually.

Annealing Box—A box, usually of cast iron, in which the metal to be annealed, usually steel, is packed with lime, ashes, sand or other material which will hold the heat and retard the cooling.

Anode—The positive terminal or connection of any source of electricity, as a battery, or where the current goes *into* a plating bath.

Anvil—(Fig. 3). A block of iron or steel on which metals are hammered or forged. A steel face is nearly always provided. A square hole at the back end holds hardies, fuller blocks, and similar tools. The pointed end is called the horn. The name is also applied in drop and steam hammers to the block which resists the blow of the hammer.

Apron—A protecting or covering piece which incloses or covers any mechanism, as the apron of a lathe. In some sections this name is also applied to the swivel or harp of a planer tool head. (See Lathe Apron, Fig. 271 A).

Arbor—(Fig. 4). A shaft or bar for holding cutters, saws, or other cutting tools. This term is used indiscriminately with "mandrel," which is for holding work to be turned, milled, ground, etc. (See Mandrel.)

Arc—A part of a circle. Also the passage of a current of electricity across the space between two separated points.

Armature—Usually the revolving part of a dynamo or motor, or the movable part of any magnetic device.

B

Babbitt Metal—A good mixture for bearings where the load is not too heavy. The so-called genuine babbitt is made of 96 parts tin, 8 parts antimony, and 4 parts copper. Cheaper substitutes are often used under the name of babbitt.

Back-lash—Usually applied to lost motion in gears, sometimes to a screw in a nut.

Backing-off—Removing metal behind the cutting edge to relieve friction in taps, reamers, drills, etc. Also called "relieving."

Back Rest—A rest attached to the lathe ways for supporting long, slender shafts or other work being turned. (See Fig. 321.)

Balance, Running—High-speed pulleys require balancing by running at speed and seeing that they run without tremor or vibration. This is called running balance.

Balance, Standing—When a pulley has been balanced on the balancing ways it is called a standing balance. (See Balance-running.)

Balancing Ways—(Fig. 5). Level strips or ways on which the shaft carrying the pulley or other revolving body is placed to determine its balance. Also made so that the shaft rests on large disks mounted on ball-bearings, and which need not be level as in the case of the flat ways. If the piece is unbalanced the heavy side will roll to the bottom.

Ball Reamer—See Reamer, Ball.

Bastard—Not regular. The term is usually applied to a file, meaning a cut between the rough and second cut, or to a thread, meaning one that is not of the standard proportions.

Battery—A combination of chemicals and metals which will give off an electric current.

Bearings, Ball—(Figs. 6–7). Bearings in which balls are placed between the bearing surfaces. These are made in various ways, but all aim to have a rolling instead of a sliding action. They are made with two-, three-, and four-point bearings, and are divided into two general classes, radial and thrust.

Bearing, Roller—(Figs. 8–9). Similar to ball-bearings except rollers are used instead of balls. In some cases the rollers are practically hollow round springs from square stock. These are known as flexible roller bearings (Hyatt).

Belt Carrier—A pulley for supporting a long belt between driving and driven pulleys. May or may not have flanges.

Belt Dressing—A preparation for preserving or cleaning a belt or making it cling to pulleys.

Belt Fastener—(Fig. 10). Hooks or other devices for joining the ends of belts.

Belt Lacing—(Fig. 11). A method of fastening ends of belts with a more or less flexible joint by means of leather or wire lacing.

Belt, Muley—A belt running around a corner guided by idler pulleys on a muley shaft.

Belt Polisher or Strap—A belt covered with glue and emery or other abrasive is driven over pulleys and work held against it.

Belt Shifter—A device for shifting belt or belts on countershaft or elsewhere from loose to tight pulleys, and vice versa. These are made in many varieties. Not used where clutches are employed.

Belt Tightener—One or more loose pulleys arranged for taking up slack of belts; often called idlers.

Bench—The usual height is 34 to 35 inches from floor to top of bench, width about 29 inches. Should be 3 inches from wall to allow circulation of air, in order to give sprinklers a chance at a fire underneath.

Bench, Leveling—A bench with a level surface so that work can be laid on it to test. Made of iron.

Bending Machine—A machine for bending rods, beams, rails, plate, etc. Run by hydraulic or other power.

Bevel—(Fig. 12). A tool for measuring or laying off bevels. Also a surface not at right angles to the main surface. When at 45 degrees it is sometimes called a miter.

Block, Chain—(Fig. 13). A hoisting device in which chains are used in connection with gears and pulleys for handling heavy loads.

Block, Differential—A hoisting apparatus consisting of differential gears to secure a large ratio between the hand chain and the load chain.

Block, Tackle—(Fig. 14). Sheaves or pulleys mounted in a shell or case, used with hoisting ropes or chains to raise heavy weights.

Blow Pipe—(Figs. 15–16). A pipe for blowing a jet of air into a flame for heating work locally, such as soldering. The upper picture is a plain one for use with an alcohol lamp, the other has a gas and an air tube. Each is regulated by the small valve so as to make the hottest flame.

BOLTS.

A. L. A. M. Bolt—(Fig. 17). This bolt is adopted by the Association of Licensed Automobile Manufacturers. It has a slotted head and castellated nut.

Boiler Patch Bolt—(Fig. 18). A bolt used in fastening patches on boilers. The patch is countersunk for the cone head, and boiler shell tapped for bolt thread. The square head is knocked off after bolt is screwed in place.

Coupling Bolt—(Fig. 19). A bolt for shaft couplings is finished all over and must be a close fit in the hole reamed in the two flanges of the coupling, so that the sections shall be rigidly secured together.

Deck—(Fig. 20).

Eye—(Fig. 21).

Hanger Bolt—(Fig. 22). This bolt is used for attaching hangers to woodwork and consists of a lag screw at one end with a machine bolt thread and nut at the other.

Loom or Carriage—(Fig. 23).

Machine Bolt, Hexagon Head—(Fig. 24).

Machine Bolt, Round Head—(Fig. 25).

Machine Bolt, Square Head—(Fig. 26).

Stove Bolt—Stove bolts are made in sizes ranging from $\frac{1}{8}$ to $\frac{3}{8}$ inch. There is no standard form of thread for these bolts to which all makers adhere, and even the same makers in some cases have a different shape of thread for different sizes of bolts. The heads commonly formed are the round, or button head, and the flat or countersunk head.

Round or Button Head—(Fig. 27).

Flat or Countersunk Head—(Fig. 28).

Tap Bolt—Tap bolts are usually threaded the full length of the body, which is not machined prior to running on the die. Only the point and the under side of the head are finished. They are not hardened and are used as a rule for the rougher classes of machine work. The heads are the same width as machine bolt heads.

Hexagon Head—(Fig. 29).

Square Head—(Fig. 30).

T-Head Planer Bolt—(Fig. 31). A bolt with a T-head having oblique ends which may be dropped into the T-slot of a planer and locked by giving it a quarter turn, until the sloping ends strike against the sides of the slot. Commonly employed for holding work on the planer table.

Tire—(Fig. 32).

Track—(Fig. 33).

Bolt Cutter—(Fig. 34). A machine for cutting threads on bolts.

Bolt Header—A machine for upsetting the bolt body to form the head.

Bolster—A block sometimes called the die block, in which a punch press die is held. It is attached to the bed by bolts at either end.

Boring and Turning Mill—(Fig. 35). A machine having a rotating horizontal table for the work with one or more stationary vertical tools for boring, turning, or facing; a turret is often provided for holding a number of tools in one of the heads. Often called "vertical mill." Horizontal boring machines are not called "mills."

Boring Machine, Horizontal—A boring machine with one or more horizontal boring bars.

Box Chuck—See Chuck, Box.

Brass—An alloy of copper and zinc although a little tin is often added for strength and density. Common proportion is copper 66, zinc 34. (See bronzes, also low and high brass.)

Brass, High—Only applied to rolled material. Two parts copper, one of zinc. Color is light yellow.

Brass, Low—Only applied to rolled material. Ranges from 75 per cent. copper to 25 of zinc to 88 per cent. copper and 12 of zinc.

Brazing—The joining of metals by the use of copper filings or chips and borax or some other flux. This is usually called spelter or hard solder and can be applied to almost any of the harder metals.

Brazing Clamps—Clamps to hold the ends of band saw or other work for brazing.

Broach—(Fig. 37). A tool which is practically a series of chisels or cutting edges for enlarging holes or changing their shape. Generally used for odd shaped holes, but occasionally for rounds. The teeth should be on an angle to give a shearing cut. The name is sometimes given to a small reamer used by jewelers.

Bronzes—Alloy of copper and tin. Used in coinage, in bells, statuary, musical instruments, and mirrors. Bell metal is 80 copper, 20 tin to 84 copper, 16 tin.

Bulldozer—A heavy forming machine for bending iron or steel and in which the dies move horizontally. Very similar to a forging press.

Bull Blocks—Blocks through which wire or rods are drawn to reduce size.

Bull Wheel—A name usually applied to the gear of a planer which meshes into the rack under the table and drives it.

Bunsen Burner—(Fig. 38). A device for securing a very hot flame by mixing air and gas in a chamber behind the flame. The one shown has two pieces which make the flame flat instead of round.

Burnisher—A tool of hardened and polished steel for finishing brass and softer metals by friction. It is held against the revolving work and gives a smooth surface by compressing the outer layer of the metal.

Burr—An edge raised by a dull cutting tool or in other ways. In some

places nuts are called "burrs," and in others the name is applied to the washers used with rivets.

Burring Machine—For removing burrs from hot pressed nuts.

Bushing—A tube or shell which reduces the diameter of a hole. Hardened steel bushings are used in jig work to guide drills or other tools.

Butt Joint—See Joint, Butt.

Butt Weld—See Weld, Butt.

Button—(Fig. 39). A steel bushing, hardened and ground, used for locating a jig plate or some similar piece in which holes have to be bored in exact position. The button is attached to the work by a small screw and is then adjusted by a micrometer or otherwise until it is central at the exact point where it is desired to bore the hole. The work is then placed on the face plate of the lathe, and with a test indicator resting on the outside of the button, the piece is readily set central. It is then clamped fast to the face plate, the button is removed, and the hole bored. Frequently, several buttons are used on the same piece of work, their relative positions being adjusted to conform to the center distances required between holes. The work is then indicated true by each button in succession, and one hole after another bored.

C

CALIPERS.

Firm Joint Caliper—(Fig. 40). A caliper having a large, firm joint in place of old style plain riveted joint. This is an inside caliper.

Gear Tooth Caliper—(Fig. 41). A caliper with two beams at right angles. The vertical beam gives tooth depth to pitch line and the other the thickness at pitch line. Both have verniers. Used in measuring teeth for accuracy.

Hermaphrodite Caliper—(Fig. 42). A combination of one leg of a divider and one leg of a caliper. Used in testing centered work and in laying off distances from the edge of a piece.

Keyhole Caliper—(Fig. 43). A caliper having one straight leg and the other curved.

Micrometer Caliper—(Fig. 44). A measuring instrument consisting of a screw and having its barrel divided into small parts so as to measure slight degrees of rotation. Usually measure to thousandths, sometimes to ten-thousandths.

Micrometer Caliper, Square—(Fig. 45). A beam caliper having jaws square with the blade, and having a micrometer adjustment to read to thousandths of an inch.

Odd Leg Caliper—(Fig. 46). A caliper having both legs pointing in the same direction. Used in measuring shoulder distances on flat work, boring half round, boxes, etc.

Outside, Spring Caliper—(Fig. 47). A tool for measuring the outside diameter of work. Controlled by spring and threaded nut. Nuts are sometimes split or otherwise designed to allow rapid movement when desired, final adjustment being made by screw.

Slide Caliper—(Fig. 48). A beam caliper made with a graduated slide. Generally made small for carrying in the pocket.

Thread Caliper—(Fig. 49). Similar to outside calipers except it has broad points to go over the tops of several threads.

Transfer Caliper—(Fig. 50). A caliper which can be set to a given size, the auxiliary arm set, and the calipers opened at will, as they can be reset to the auxiliary arm at any time. Used to caliper recesses and places where they must be moved to get them out.

Vernier Caliper—(Fig. 51). A beam caliper arranged for reading fine measurements by the Vernier method.

CAMS.

Drum or Barrel—(Fig. 52). The drum cam has a path for the roll cut around the periphery, and imparts a to-and-fro motion to a slide or lever in a plane parallel to the axis of the cam. Sometimes these cams are built up of a plain drum with cam plates attached.

Edge—(Fig. 53). Edge or peripheral cams (also called disk cams) operate a mechanism in one direction only, gravity, or a spring being relied upon to hold the cam roll in contact with the edge of the cam. On the cam shown, *a* to *b* is the drop; *b* to *c* the dwell; *c* to *d*, rise; *d* to *a*, dwell.

Face Cam—(Fig. 54). Face cams have a groove or roll path cut in the face and operate a lever or other mechanism positively in both directions, as the roll is always guided by the sides of the slot.

Linear Cam—(Fig. 55). A curved or formed slot or guide which moves back and forth, or which guides a moving part, but which is flat and does not revolve.

"C" Clamp—See Clamp "C."

"C" Washer—See Washer, Open.

Carbonizing—The heat treatment of steel so that the outer surface will be hard. The surface absorbs carbon from the material used.

Case-hardening—A surface hardening by which the outer skin of a piece of iron or steel absorbs carbon or carbonizes so as to harden when cooled in water. The piece is usually packed in an iron box with bone, leather, or charcoal, or all three, and heated slowly several hours, then quenched.

Cat Head—A collar or sleeve which fits loosely over a shaft and is clamped to it by set screws. Used for steady rest to run on where it is not desired to run it on the work.

Same name is also given to the head carrying cutters on boring bars.

Cathode—The negative terminal of an electric bath or battery.

Center, Dead—The back center or the stationary center on which the work revolves. On many grinding machines both centers are dead.

Center, Live—The center in the revolving spindle of a lathe or similar machine. It is highly important that this should run true or it will cause the work to move in an eccentric path.

CENTER PUNCHES

Center Punch—(Fig 56). A punch for marking points on metal. Made of steel with a sharp point and hardened. Often called a prick punch.

Automatic Center Punch—(Fig. 57). A center punch having a spring actuated hammer in the handle, which is released when the handle is pressed way down. The point can be placed where desired and the blow given by a pressure of the hand. In some cases the blow can be varied.

Bell or Self-centering Center Punch—(Fig. 58). A center punch sliding in a bell- or cone-mouthed casing so when placed square over the end of any bar it will locate the center with sufficient accuracy for most purposes.

Locating Center Punch—(Fig. 59). Having an extra leg which has a spring point and is adjustable. The spring point is placed in the first punch mark and so locates the next punch mark at the right distance from the first.

Centering Machines—A machine for drilling and reaming center of work for the lathe or grinder.

Chamber—A long recess. See Recess.

Chaser—(Fig. 60). Tool used for cutting threads by chasing. Usually have several teeth of right pitch, but name is sometimes applied to a single-point tool used in brass work on a Fox lathe. Chasers are made circular or flat and in the old days many were used by hand.

Chasing Threads—Cutting threads by moving a tool along the work at the right speed to give the proper pitch. Distinguishes between threads cut with a die and those cut with a threading tool.

Chattering—A slight jumping of the tool away from the work or vice-versa, and which leaves little ridges in same direction as the

teeth. Occurs at times in any class of work and with any kind of tool. Due to springing of some parts of the machine.

Chipping—The cutting of metal with a chisel and hammer. The name is also given to the breaking away of small pieces around the edge of a hole, the cracking out of enamel, etc.

CHISELS

Blacksmith's Hot Chisel—(Fig. 61). A chisel for cutting hot metal. Has a handle so that it can be used without getting the hand too near the heated metal.

Cape Chisel—(Fig. 62). Chisel with a narrow blade for cutting key-ways and similar work.

Cold Chisel—(Fig. 63). The usual machinists' chisel for cutting or "chipping" metal with a plain cutting edge as in illustration.

Diamond or Losenge Chisel—(Fig. 64). Similar to a cape chisel but with square end and cutting edge at one corner. Used for cutting a sharpbottomed groove.

Round Chisel—(Fig. 65). A round-end chisel with the cutting edge ground back at an angle. Used for cutting oil grooves and similar work.

CHUCKS

Box Chuck—(Fig. 66). A form of chuck with a box or rectangular body. Used mostly in brass work.

Cat Head Chuck—(Fig. 67). A chuck in which the work is driven by a number of set screws tapped through the wall of the chuck.

Draw or Spring Chuck—(Fig. 68). A chuck operated by moving longitudinally in a taper bearing. Used on precision work.

Drill Chuck—(Fig. 69). A chuck made especially for holding drills in drilling machines. Sizes run from the smallest up to one inch.

Lathe Chuck—(Fig. 70). A device for holding work. Usually screw on spindle and have two, three, or four jaws. These may be independent or move together by screws only (in case of two jawed) or screws and gears in case of more than two. There is also a spiral or scroll chuck without gears or screws of the ordinary kind.

Magnetic Chuck—(Fig. 71). A holding device which has no jaws but which holds iron and steel by magnetic attraction. Used in light planing, turning and grinding work.

Master Chuck—(Fig. 72). The main body of a screw chuck which screws on the nose of the lathe spindle and which carries the sub- or screw-chuck for holding the work. Mostly used in brass work.

Nipple Chuck—A chuck for holding short piece of pipe to be threaded.

Oval Chuck—A chuck designed to move the work to and from the tool so as to produce an oval instead of a round. Sometimes called an elliptic chuck.

Planer Chuck—A chuck for holding work on bed or platen of planer, shaper, or milling machine. Sometimes called a vise. They are made with both plain and swivel bases, and usually have locking strips which hold the piece carrying the set screws.

Plain Base—(Fig. 73).

Swivel Base—(Fig. 74).

Screw Chuck—A chuck made with internal or external thread to hold work which has been already threaded. These very often screw into a master chuck. Mostly used in brass work.

Spring Chuck—See Screw Machine Tools.

Chucking Machine—A lathe which usually has a turret for tools, a revolving chuck or table for work, and generally used for boring and reaming. May be either vertical or horizontal.

Circuit—The path in which an electric current flows.

CLAMPS

Clamp, "C"—(Fig. 75). Clamp shaped like a letter "C" for holding work in various ways. Are sometimes cast but more often drop forged for heavier work.

Clamps, Machinist—(Fig. 76). Clamps for holding work together, holding jigs or templets on work, etc.

Toolmakers' Clamp—(Fig. 77). A small clamp with a sliding jaw made especially for toolmakers' work.

Clash Gears—Gears which are thrown into mesh by moving the centers together and sometimes by sliding the gears on parallel shafts till the teeth get a full bearing. The latter are sometimes called sliding gears.

Clutch—Any device which permits one shaft to engage and drive another, may be either friction or positive, usually the former. Made of all sorts of combinations of cams, levers, and toggles.

Ratchet Tooth Clutch—(Fig. 78).

Square Jaw Clutch—(Fig. 79).

Clutch, Friction—A device whereby motion of loose pulley is transmitted to shaft to be driven. Various methods are employed but all depend on forcing some kind of friction surfaces together so that one drives the other.

Collar—(Fig. 80). A ring used for holding shafting, loose pulleys, in proper position or for fastening to boring tools to prevent them going in too deep.

Collar, Safety—(Fig. 81). Having a clamping device instead of set screw or having set screw below surface or so covered as not to catch anything brought in contact with it.

Commutator—The part of a dynamo or motor which takes off or leads current into the machine.

Compound Rest—See Rest, Compound.

Cotter, Spring—(Fig. 82). A piece of half round stock bent to have an eye at one end and to form a round pin when pressed together. It is used in a hole drilled crosswise in the ends of studs and bolts to keep a nut or collar from coming off. Also called a split cotter or split pin.

Counter, Revolution—(Fig. 83). A device for counting the revolutions of a shaft. Generally made with a worm and a gear having 100 teeth so that one turn of dial equals 100 revolutions of the shaft.

Counterbore—(Fig. 84). A tool similar to an end cutting reamer with a pilot to fit a hole already bored.

Countershaft—(Fig. 85). A combination of hangers, shafting, and pulleys which is driven from a line shaft and in turn drives the machine.

COUPLINGS

Clamp Coupling—(Fig. 86). A coupling made in two or more parts, clamping around the shafts by transverse bolts. Hold either by friction or have dowels in shaft. Sometimes called compression although this is confusing.

Compression Coupling—(Fig. 87). A coupling which grips shafting by drawing together tapered parts. This forces them against shaft and holds it firmly. Bolts parallel with shaft draw parts together.

Flanged Coupling—(Fig. 88). A coupling in which a flange is keyed to each shaft and these flanges are bolted together. Also called "plate" coupling.

Jaw or Clutch Coupling—A coupling which engages positively by jaws or projections on the faces of opposite parts.

Shaft Coupling—Any device for fastening the ends of different pieces of shafting together.

Cope—The upper part of a flask for holding a mold.

CRANES

Crane—A device for lifting and carrying any weight. This may be done in a great variety of ways as swinging or otherwise moving after the load is lifted.

Jib Crane—(Fig. 89). A crane with a swinging arm or boom.

Portable Crane—(Fig. 90). A hoisting frame on wheels which can be run around to the work and used to handle work in and out of lathes and other machines.

Swing Crane—Same as Jib Crane.

Traveling Crane—A crane with a bridge or cross beam having wheels at each end so it can be run on overhead tracks to any point in the shop.

Crimping—Fluting, corrugating, or compressing metal ring to reduce its diameter.

Cross-rail—The part of a planer, boring mill, or similar machine on which the tool heads or slides move and are supported.

Cut Meter—(Fig. 91). An instrument for measuring the surface speed of work either in lathe or planer. A wheel is pressed against the moving surface and the speed is shown in feet per minute.

Cutter, Flue Sheet—(Fig. 92). A special cutter for making holes as for flues, in flue sheets or in other sheet-metal or structural work.

CUTTERS, MILLING

Angular Cutters—(Figs. 93–94–95). Such cutters are used for milling straight and spiral mills, ratchet teeth, etc. Cutters for spiral mill grooving are commonly made with an angle of 12 degrees on one side and 40, 48, or 53 degree angle on the other.

Concave and Convex Cutters—(Figs. 96–97). Concave and convex cutters are used for milling half circles. The convex cutter is often used for fluting taps and other tools. Like all other formed cutters the shape is not affected by the process of sharpening.

Corner Rounding Cutters—(Figs. 98–99–100). Left-hand double and right-hand cutters of this type are used for finishing rounded corners and edges of work. The shape of the cutter is not altered by grinding on the face of the teeth.

Cotter Mill—(Fig. 101). This type of mill is used for cutting keyseats and other slots and grooves.

Dovetail Cutters—(Figs. 102–103). Male and female dovetails are milled with these tools, and edges of work conveniently beveled.

End Mill—(Fig. 104.) This mill sometimes called a butt mill, is used for machining slots, milling edges of work, cutting cams, etc.

End Mill (with center cut)—(Fig. 105). This end mill has clearance on the inner side of the end teeth and is adapted to cut into the work to a depth equal to the length of the end teeth and then feed along, dispensing with the necessity of first drilling a hole, which has to be done when the inner sides of the teeth are not relieved.

The mills are often used for heavy cuts particularly in cast iron.

Face and Formed Cutters—(Figs. 106–112). The face cutter to the left, of Brown & Sharpe inserted tooth type is made in large sizes and cuts on the periphery and ends of teeth.

The formed cutter to the right may be sharpened by grinding on the face without changing the shape. For milling wide forms several cutters are often placed side by side in a gang.

Fish Tail Cutter—(Fig. 107). A simple cutter for milling a seat or groove in a shaft or other piece. Usually operated at rapid speed and light cut and feed.

Fluting Cutters—(Figs. 108–109–110). Fig. 8 is an angular mill for cutting the teeth in spiral mills, Fig. 110 is for tap fluting and Fig. 109 for milling reamer flutes. In each case the cutter is shown with one face set radial to the center of the work.

Fly Cutters.—(Fig. 11). Fly cutters are simple formed cutters which may be held in an arbor like that shown at the top of the group. The arbor is placed in the miller spindle and the tool or other work to be formed is given a slow feed past the revolving cutter. After roughing out, the cutter can be held stationary and used like a planer tool for finishing the work which is fed past it and so given a scraping cut.

Gang Cutters—(Fig. 113). Cutters are used in a gang on an arbor for milling a broad surface of any desired form. The cutters shown have interlocking and overlapping teeth so that proper spacing may be maintained. In extensive manufacturing operation the gangs of cutters are usually kept set up on their arbor and never removed except for grinding.

Gear Cutter (Involute)—(Fig. 114). In the Brown & Sharpe system of involute gear cutters, eight cutters are regularly made for each pitch, as follows:

No. 1 will cut wheels from 135 teeth to a rack.
No. 2 will cut wheels from 55 teeth to 134 teeth.
No. 3 will cut wheels from 35 teeth to 54 teeth.
No. 4 will cut wheels from 26 teeth to 34 teeth.
No. 5 will cut wheels from 21 teeth to 25 teeth.
No. 6 will cut wheels from 17 teeth to 20 teeth.
No. 7 will cut wheels from 14 teeth to 16 teeth.
No. 8 will cut wheels from 12 teeth to 13 teeth.

Such cutters are always accurately formed and can be sharpened without affecting the shape of the teeth.

Gear Cutters, Duplex—(Fig. 115). The Gould & Eberhart duplex cutters are used in gangs of two or more, the number of cutters in the gang depending on the number of teeth in the gear to be cut. The following table gives the number of cutters which may be used in cutting different numbers of teeth.

Under	30 teeth	1 cutter
Under	30 teeth	2 cutters
Over	50 teeth	3 cutters
Over	70 teeth	4 cutters
Over	95 teeth	5 cutters
Over	120 teeth	6 cutters
Over	150 teeth	7 cutters
Over	180 teeth	8 cutters
Over	230 teeth	10 cutters
Over	260 teeth	12 cutters.

Gear Stocking Cutter—(Fig. 116). The object of stocking cutters is to rough out the teeth in gears, leaving a smaller amount of metal to be removed by the finishing cutter. They increase the accuracy with which gears may be cut, and save the finishing cutter as well.

In all cases where accuracy and smooth running are necessary the gears should first be roughed out. One stocking cutter answers for all gears of the same pitch.

Hob—(Fig. 117). A form of milling cutter with teeth spirally arranged like a thread on a screw and with flutes to give cutting edges as indicated. Used for cutting the teeth of worm gears to suit the worm which is to operate the gear. Hobs are formed and backed off so that the faces of the teeth may be ground without changing the shape.

Inserted Tooth Cutter—(Fig. 118). Brown & Sharpe inserted tooth cutters have taper bushings and screws for holding the blades in position in the bodies. Inserted tooth construction is generally recommended for cutters 6 inches or larger in diameter. There are many types of inserted tooth cutters and in most cases the blades are readily removed and replaced when broken or worn out.

Inserted Tooth Cutter (Pratt & Whitney)—(Fig. 119). In this type of cutter the teeth or blades are secured in position by taper pins driven into holes between every other pair of blades; the cutter head being slotted as shown to allow the metal at each side of the taper pin to be pressed firmly against the inserted blades.

Interlocking Side Cutters—(Fig. 120). These cutters have overlapping teeth and may be adjusted apart to maintain a definite width for milling slots, etc., by using packing between the inner faces.

Plain Cutters—(Figs. 121–122). These cutters are for milling flat surfaces. When over $\frac{3}{4}$ inch wide the teeth are usually cut spirally at an angle of from 10 to 15 degrees, to give an easy shearing cut. When of considerable length relative to diameter they are called slabbing mills.

Rose Cutter—(Fig. 123). The hemispherical cutter known as a rose mill is one of a large variety of forms employed for working out dies and other parts in the profiler. Cutters of this form are also used for making spherical seats for ball joints, etc.

Screw Slotting Cutter—(Fig. 124). Screw slotting cutters have fine pitch teeth especially adapted for the slotting of screw heads and similar work. The cutters are not ground on the sides. They are made of various thicknesses corresponding to the numbers of the American Wire Gauge.

Shank Cutter—(Fig. 125). Shank milling cutters are made in all sorts of forms with shanks which can be conveniently held true in miller or profiler while in operation.

Shell End Cutter—(Fig. 126). Shell end mills are designed to do heavier work than that for which the regular type of end mills are suited. They are made to be used on an arbor and are secured by a screw in the end of the arbor. The end of the cutter is counterbored to receive the head of the screw and the back end is slotted for driving as indicated.

Side or Straddle, and Slabbing Cutters—Side cutters like that to the left on the periphery and sides, are suitable for milling slots and when used in pairs are called straddle mills. May be packed out to mill any desired width of slot or opposite faces of a piece of any thickness.

Slabbing cutters are frequently made with nicked teeth to break up the chip and so give an easier cut than would be possible with a plain tooth.

Side—(Fig. 127).

Slabbing—(Fig. 128).

Slitting Saw, Metal—(Fig. 129). Metal slitting saws are thin milling cutters. The sides are finished true by grinding, and a little thicker at the outside edge than near the center, for proper clearance. Coarse teeth are best adapted for brass work and deep slots and fine teeth for cutting thin metal.

Sprocket Wheel Cutter—(Fig. 130). Cutters for milling the teeth on sprocket wheels for chains are formed to the necessary outline and admit of grinding on the face like regular gear cutters, without changing the form of the tooth.

Straight Shank Cutter—(Figs. 131–132). Straight shank cutters of small size are extensively used in profilers and vertical millers for die sinking, profiling, routing, etc. They are held in spring chucks or collets.

T-Slot Cutter—(Fig. 133). Slots for bolts in miller and other tables are milled with T-slot cutters. They are made to standard dimen-

sions to suit bolts of various sizes. The narrow part of the slot is first milled in the casting, then the bottom portion is widened out with the T-slot cutter.

Cutting-off Machine—(Fig. 134). For cutting desired lengths from commercial bars of iron, steel or other material, usually has stationary tools and revolves the work. The latter is gripped by rotating chuck; and as the tools are fed toward the center, the spindle in some types of machines is driven at an accelerated speed so that as the diameter of the cut is reduced, the speed of rotation is increased to maintain a practically uniform surface speed of work. In cold-saw cutting-off machines, the work is held in a vise and a rotating circular cutter is fed against it. Such machines are used not only for severing round stock, but also for cutting off square and rectangular bars, rails, I-beams, channels and other structural steel shapes.

Cutting-off Tool Post—(Fig. 135). The tool block used on the cross slide of a turret lathe or other machine for carrying the tool for cutting off the completed piece of work from the bar of material held in the chuck. The tool post may be made to receive a straight tool or a circular cutter.

D

Dead Center—(See Center, Dead).

Derrick—A hoisting device consisting of a fixed upright and an arm hinged at bottom, which is raised and lowered and usually swings around to handle heavy loads.

Dial Feed—A revolving disk which carries blanks between the punch and die.

Diamond Hand Tool—(Fig. 136). A hand tool with a diamond in the end. Used for dressing grinding wheels after they have been roughed out with the cheaper form of cutters. Fixed diamonds are usually considered better than those held by hand.

Die, Bolt—(Fig. 137). A die for cutting bolts. Some are solid and others adjustable. Some are for use in hand die stocks or plates, but they are mostly used in machine bolt cutters.

Die Chasers—(Fig. 138). Cutters which are inserted in a die head for cutting a thread on bolts and screws.

Die, Master—A standard die used only for reference or for sizing taps.

Die, Screw Plate or Stock—(Fig. 139). A frame or handle for holding a threading die. Sometimes dies and handles are of one piece.

Die, Spring or Prong—See Screw Machine Tools.

DIES, PUNCH PRESS

Bending Dies, Plain—(Fig. 140). Simple bending dies are made with the upper face of the die and the bottom of the punch shaped to conform to the bend it is desired to give the blank. A common type is shown in the engraving.

In simple bending dies the upper face of the die is cut out to the desired form and the piece of work formed to required shape by being pressed directly down into the die by the punch.

Blanking Dies—(Fig. 141). Blanking dies are about the most commonly used of all the varieties of press tools. A simple form of die is seen in the illustration. The strip of sheet metal is fed under the stripper and is prevented by that member from lifting with the punch upon the up-stroke, following the punching out of the blank. Where several punches are combined in one hole for blanking as many pieces simultaneously, they are known as multiple blanking tools.

Drawing Dies, Plain—(Fig. 142). Dies of the type shown can be used for shallow drawing only, as there is no pressure on the blank to prevent its wrinkling when forced down into the die by the punch. The blank fits the recess *A* in the upper face of the die and the die itself which is slightly tapering is made the diameter of the punch plus twice the thickness of the wall required for the shell. The bottom edge *B* of the die strips the shell from the punch when the latter ascends.

Disk, Reference—Accurate disks of standard dimensions for setting calipers and measuring with. Usually of hardened steel.

Divider, Spring—(Fig. 143). A divider in which a spring takes up any lost motion of the screw or other adjusting device.

Doctor—A local term for adjuster or adapter so that chucks from one lathe can be used on another. Sometimes used same as "dutchman."

DOGS

Dog—A name given to any projecting piece which strikes and moves some other part, as the reversing dogs or stops on a planer or milling machine. Sometimes applied to the pawl of a ratchet.

Bent Tail Dog—(Fig. 144). A dog with a bent tail to fit into a slot in a face plate.

Clamp Dog—(Fig. 145). A dog which grips the work by clamping instead of by a set screw.

Grinder Dog—(Fig. 146). A dog made especially for use in grinding cylindrical work.

Lathe Dog—Any dog for driving work in the lathe.

Straight Tail Dog—(Fig. 147). A dog with a straight tail which is driven by a projecting stud from the face plate.

Drag—The bottom part of a flask, sometimes called the nowel.

Draw Bench—A device for drawing wire from rods. The wire is drawn through plates or bull blocks, each successive opening being smaller than the last, until the right size is secured.

Drift—A tool for cutting out the sides of an opening by being driven through with a hammer. Similar to a broach.

DRILLS

Center Drill—(Fig. 148). The short drills used for centering shafts before facing and turning are called center drills. The drill and reamer or countersink for the 60 degree center hole when combined as shown allow the centering to be done more readily than when separate tools are used.

Combination—(Fig. 149).

Core Drill—(Fig. 150). The core drill is a hollow tool which cuts out a core instead of removing the metal in the form of chips. Such drills are generally used to procure a core from the center of castings or forgings for the determination of the tensile strength or other physical properties of the metal.

Gun Barrel Drill—(Fig. 151). Gun barrel drills are run at high speed and under very light feed, oil being forced through a hole in the drill to clear the chips and cool the cuting point and work. The drill itself is short and fastened to a shank of suitable length.

Hog Nose Drill—More like a boring tool. Mostly used for boring out cored holes. Must be very stiff to be effective but when made right and used to advantage, does lots of hard work.

Hollow Drill—(Fig. 152). The hollow drill is for deep-hole drilling. It has an opening through the body and is attached to a shank of the necessary length for the depth of hole to be drilled.

Oil-drill (Morse)—(Fig. 153). These drills convey lubricant to the point, through holes formed in the solid metal. Where the drills are larger than 2½ inches an inserted copper tube is employed to carry the oil to the drill point and wash out the chips and keep the drill cool. The oil enters through the hollow shank or through a connection at the side as shown.

Ratchet Drill—The square taper shanks of these drills are made to fit a ratchet for drilling holes by hand.

Flat—(Fig. 154).

Twist—(Fig. 155).

Shell Drill—(Fig. 156). Shell drills are fitted to a taper shank and used for chucking out cored holes and enlarging holes drilled with a two-flute twist drill. The angle of the spiral lips is about 15 degrees.

Straight Flute Drill—(Fig. 157). The straight flute, or "Farmer" drill as it is frequently called after its inventor, does not clear itself as well as the twist drill does, but is stiffer, and does not "run" or follow blow-holes or soft spots as readily as the twist drill. It is also better for drilling brass and other soft metals.

Three- and Four-groove Drills—(Fig. 158). Where large holes are to be made in solid stock, it is advisable to use a three- or four-groove drill after running the required two-flute drill through the piece. These drills will enlarge the hole to the size required and are also useful in boring out cored holes in castings.

Twist Drill—(Fig. 159). Usually made with two flutes or grooves, running around the body. This furnishes cutting edges and the chips follow the flutes out of the hole being drilled.

Twisted Flat Drill—(Fig. 160). A drill made by twisting a piece of flat steel instead of milling the grooves from a round bar.

Drill, Chain—A device to be used in connection with a brace or breast drill in many places where it is not convenient to bring a ratchet drill into use.

Drill Speeder—A device which goes on drill spindle and gears up the speed of drills so that small drills can be used economically on large drill presses.

Drill Vise—See Vise, Drill.

DRILLING MACHINES

Drill Press—A name given to almost any type of drilling machine having a vertical spindle.

Radial Drill, Plain—A drilling machine with the drilling spindle on a swinging arm.

Radial Drill, Semi-universal—A radial drilling machine in which the drilling spindle swivels on its saddle for drilling holes at an angle, toward or away from the post or column.

Radial Drill, Universal—(Fig. 161). A radial drilling machine in which the drilling spindle swivels on its saddle as in the semi-universal and the whole arm also swings on the arm girdle. Also called a full universal.

Ratchet Drill—(Fig. 162). A device for turning a drill when the handle cannot make a complete revolution. A pawl on the handle drops into a ratchet wheel on the barrel so that it can be turned one or more teeth.

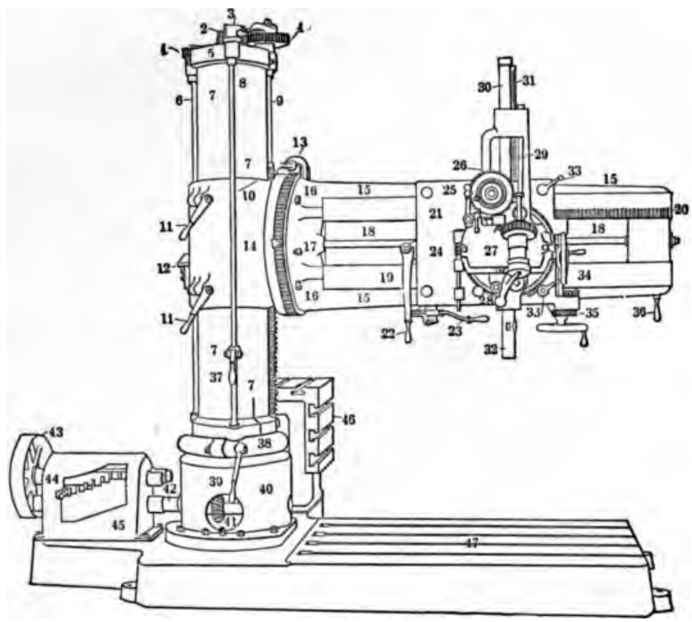


Fig. 161.

Drill, Radial—Parts of

1. Vertical driving-shaft gear.
2. Center driving-shaft gear.
3. Elevating tumbler-plate segment.
4. Elevating-screw gear.
5. Column cap.
6. Vertical driving shaft.
7. Column sleeve.
8. Elevating-lever shaft.
9. Elevating screw.
10. Arm girdle.
11. Arm-binder handle.
12. Arm-miter gear guard.
13. Arm-worm box.
14. Arm pointer.
15. Full universal arm.
16. Arm-clamping nuts.
17. Arm-dowel pin.
18. Arm shaft.
19. Arm ways.
20. Arm rack.
21. Saddle.
22. Reversing lever.
23. Back-gear lever.
24. Head-swiveling worm.
25. Feed-trip lever.
26. Index gear.
27. Universal head.
28. Quick-return lever.
29. Feed-rack worm shaft.
30. Spindle sleeve.
31. Feed rack.
32. Spindle.
33. Saddle-binding lever.
34. Feed hand wheel.
35. Head-moving gear.
36. Arm-swinging handle.
37. Elevating lever.
38. Clamping ring.
39. Clamping-ring handle.
40. Column.
41. Column driving-miters.
42. Driving-shaft coupling.
43. Driving pulley.
44. Speed-change lever.
45. Speed-box case.
46. Box table.
47. Base.

Upright Drill—(Fig. 163). A drilling machine with a vertical frame and a vertical spindle.

Drive or Force Fit—See Fit.

Dry Sand Molds—See Molds.

Dutchman—A local term for a wedge or liner to make a piece fit. Used to make a poor job useable. A round key or pin fitting endwise in a hole drilled half in a shaft and half in the piece to be attached thereto.

E

Ejector—An ejector on punch press work is a ring, collar or disk actuated by spring pressure or by pressure of a rubber disk, to remove blanks from the interior of compound and other dies. It is often called a shedder.

Elliptic Chuck—See Chuck, Oval.

Emery Wheel Dressers—See Grinding Wheels and Diamonds.

End Measuring Rod—See Measuring Rod.

Expanding Mandrel or Arbor—See Mandrel.

Extractor, Oil—A machine for extracting oil from iron and metal chips. Revolves rapidly and throws out the oil by centrifugal force.

F

Face Cam—See Cam, Face.

Face Plate—(Fig. 164). The plate or disk which screws on the nose of a lathe spindle and drives or carries work to be turned or bored. Sometimes applied to table of vertical boring mill.

Face Plate, Tapped—(Fig. 165). A face plate having tapped holes for bolting work to it.

Face Reamer—See Reamer, Face.

Feather—This might be called a sliding key—sometimes called a spline. Used to prevent a pulley, gear, or other part from turning on the shaft, but allows it to move lengthwise as in the feed shaft used on most lathes and other tools. Feather is nearly always fastened to the sliding piece.

Field—Usually the stationary part of a dynamo or motor.

File—A tool of hardened steel having sharp cutting points or teeth across their surface. These are forced up by a chisel and hammer.

FILES

Die Sinkers, Files, or Riffles—Double-ended files of special shapes for use in finishing up dies for embossing and similar work. They are made in a large variety of shapes.

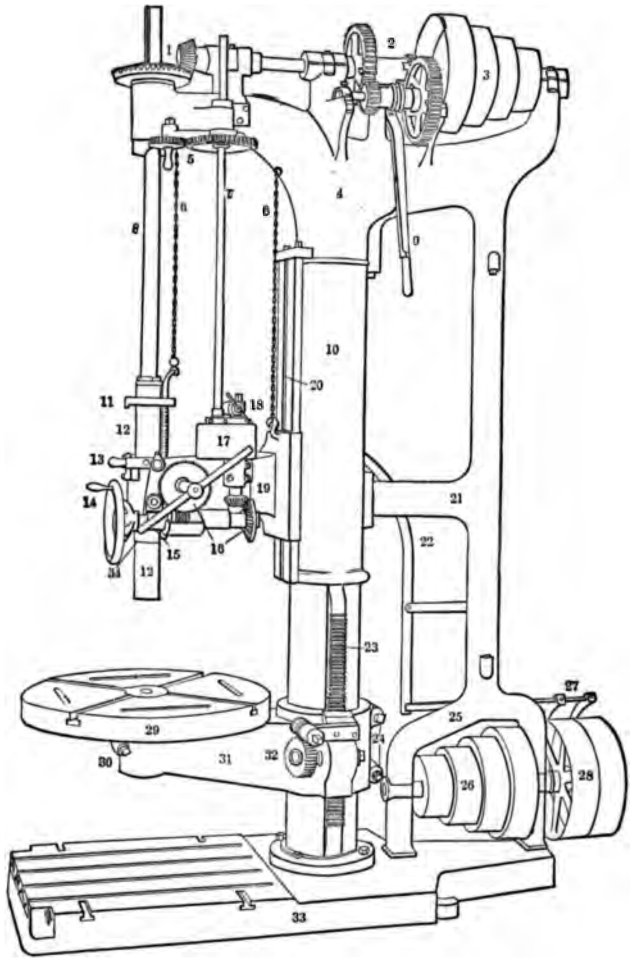


FIG. 163.

Drill Press—Parts of

1. Main driving gears, bevel.
2. Back gears.
3. Upper cone pulley.
4. Yoke to frame.
5. Feed gears.
6. Counterweight chains.
7. Feed shaft.
8. Spindle.
9. Back-gear lever.
10. Column.
11. Automatic stop.
12. Spindle sleeve.
13. Feed trip lever.
14. Hand-feed wheel.
15. Quick-return lever.
16. Feed gearing.
17. Feed box.
18. Feed-change handle.
19. Sliding head.
20. Face of column.
21. Back brace.
22. Belt shifter.
23. Rack for elevating table.
24. Table-arm clamping screws.
25. Pulley stand.
26. Lower cone pulley.
27. Belt-shifting fingers.
28. Tight and loose pulleys.
29. Table.
30. Table-clamp screw.
31. Table arm.
32. Table-adjusting gear.
33. Base.
34. Ball-thrust bearing.

File Cuts—Files are cut both double and single. The first has two sets of cuts at an angle to each other, the second has but one set of cuts. The method of designating these is shown in the illustrations, although some makers are now using 8 or 10 numbers instead of names. A No. 00 is about the same as "bastard," No. 1 equals "second cut," Nos. 2 or 3 equals "smooth" and Nos. 6 to 8 a "dead smooth."

Needle Files—Single-ended files with the handle forged solid. They are small and slender and made in various shapes.

Filing Machine—A machine which runs a file by power, usually vertically. Useful in many kinds of small work.

Fin—The thin edge or mark left by the parting of a mold or die. In drop forge work this is called the "flash."

Fit, Drive or Force or Press—Fitting a shaft to a hole by making the hole so the shaft can be driven or forced in with a sledge or some power press, often requiring many tons' pressure.

Fit, Running or Sliding—A fit with enough allowance between shaft and hole to allow it to run or slide without sticking or heating.

Fit, Shrink—The fitting of two pieces by making the hole slightly smaller than the shaft, then heating the piece with the hole till it expands enough to allow shaft to enter. When cool the shaft is very tightly seized if the allowance is right.

Fit, Wringing—A fit with a smaller allowance than for running but so that the shaft can be twisted into the hole by hand. Usually applied to some such work as a boring bar in a horizontal boring machine. Sometimes used in connection with twisting two flat surfaces together to exclude the air.

Flask—The frame which holds the sand mold for the casting. Includes both the cope and drag.

Flat Reamer—See Reamer, Flat.

Flatter, Round face—(Fig. 197). A blacksmith's tool which is held on the work and struck by a sledge. Used to take out hammer marks and smooth up a forging.

Flute—The shop name for a groove. Applied to taps, reamers, drills and other tools.

Fly-wheel—A heavy wheel for steadying motion of machinery. On an engine it carries the crank past the center and produces a uniform rotation.

Follower Rest—See Rest, Follower.

Foot Stock—The tail stock or tail block of a lathe, grinder, etc.

Force—A master punch which is used under a powerful press to form an impression in a die. Forces are commonly employed in

the making of coining and other embossing dies. A similar tool used by jewelers is called a "hub." It is sometimes referred to incorrectly as a "hob."

Forge—(Fig. 198). An open fireplace for heating metals for welding, forging, etc. Has forced draft by fan or bellows.

Forging Press—A heavy machine for shaping metal by forcing into dies by a steady pressure instead of a sudden blow as in drop forging. Similar to a bulldozer.

Fork Center—A center for driving woodwork in the lathe. Also used in hand or fox lathes for driving special work.

Fox Lathe—See Lathe, Fox.

Fuller—(Fig. 199). A blacksmith's tool something like a hammer, having a round nose for spreading or fulling the iron under hammer blowers.

Furnace, Muffle—A furnace for heating steel to harden, in which the flame does not come in contact with the metals.

Furniture, Shop—This includes tool racks, lathe pans, tote boxes, stock bins, etc., etc.

Fuse—A piece of metal which melts when too much current passes and acts as a safety valve.

G

GAGES

Center Gage—(Fig. 200). A gage for testing angle of centers and for setting thread tools square with the lathe centers.

Depth Gage—(Fig. 201). A tool for measuring the depth of holes or recesses. The body is placed across the hole while the rule is slipped down into the hole to be measured. In many cases the rod is simply a wire and not graduated.

Drill Gage—(Fig. 203). Flat steel plate drilled with different size drills and each hole marked with correct size or number.

Feeler or Thickness Gage—(Fig. 204). Has blades of different thicknesses, in thousandths of an inch, so that slight variations can be felt or measured.

Gear Tooth Depth Gage—(Fig. 202.) A gage for measuring the depth of gear teeth. Requires a different gage for each pitch.

Limit Gage—(Figs. 205–206). A plug or other gage having one end larger and the other smaller than the nominal size. If the small end of the plug goes in but the large end does not, the size is between the two and within the limits of the gage. Similarly, in the case of a female limit gage, if the large end of the gage goes over the piece of work and the small end does not go over it, the work is within

the established limits. Ordinarily, one end of a limit gage is marked "Go," and the other end "Not Go," or else they are stamped + and −.

Plug and Ring Gage—(Fig. 207). Gages for use in measuring inside and outside work or for use in setting calipers.

Radius or Curve Gage—(Fig. 208). Made like a feeler or thread gage but has each blade with a given outside radius on one end and inside radius on the other for gaging small fillets or round edges.

Scratch Gage—(Fig. 209). For scratching a line at a given distance from one side of a piece. Adjustable for different lengths.

Snap Gage—(Fig. 210). A solid caliper used for either inside or outside measurement. This shows a combined gage for outside and inside work. Sizes can be the same or give the allowance for any kind of fit desired.

Splining or Key-seat Gage—Gage for laying out key-seats on shafts.

Surface Gage—(Fig. 211). A tool for gaging the height between a flat surface such as a planer table or a surface plate and some point on the work. This can then be transferred to any other point.

Thread Gage—(Fig. 212). Tool with a number of blades, each having the same number of notches per inch as the thread it represents. Made for different kinds of threads and in various forms.

Wire Gage—(Fig. 213). Gage for measuring sizes of wire. The wire fits between the sides of the opening, not in the holes. Sometimes made in the form of a circular disk.

Worm Thread Tool Gage—For grinding thread tool for worm threads —29 degree angle.

Gang Tool—A holder with a number of tools, generally used in the planer but sometimes in the lathe. Each tool cuts a little deeper than the one ahead of it.

GEARS.

Angular Gears—A name sometimes applied to bevel gears and also to spur gears with helical or skew teeth. See those terms for definition.

Annular Gear—(Fig. 214). A toothed ring for use in universal chucks and similar places. Teeth can be on any of the four faces although when inside it is usually called an internal gear.

Bevel Gears—(Fig. 215). Gears cut on conical surfaces to transmit power with shafts at an angle to each other. When made for shafts at right angles and with both gears of the same size are often called "miter" gears. Teeth may be either straight, skew or herring bone.

Crown Gear—A gear with teeth on the side of rim. Used before facilities for cutting bevel gears existed. Seldom found now.

Elliptical or Eccentric Gears—(Fig. 216). Gears in which the shaft is not in the center. May be of almost any shape, oval, heart-shape, etc. Printing presses usually have good examples of this.

Helical Gears—(Fig. 217). Gears having teeth at an angle across the face to give a more constant pull. Also give side thrust. More often called "skew" teeth.

Herring-bone Gears—(Fig. 218). Gears having teeth cut at a double angle. Made by putting two helical or "skew" tooth gears together. Does away with side or end thrust.

Intermittent Gears—(Fig. 219). Gears where the teeth are not continuous but have plain surfaces between. On the driven gear these plain surfaces are concave to fit the plain surface of the driver and the driven wheel is stationary while the plain surfaces are in contact.

Internal Gears—(Fig. 220). Gears having teeth on the inside of a ring or shell.

Module or Metric Gears—French system of making gears with metric measurement. The module is the pitch diameter in millimeters divided by the number of teeth in the gear.

Pin Gear—Gear with teeth formed by pins such as the old lantern pinion. Also formed by short projecting pins or knobs and only used now in some feeding devices.

Quill Gears—Gears or pinions cut on a quill or sleeve.

Skew Gears—See Helical.

Spiral Gears—(Fig. 221). Spur gears with spiral teeth which run together at an angle and do the work of bevel gears.

Sprocket Gears—(Fig. 222). Toothed wheels for chain driving.

Spur Gears—(Fig. 223). Wheels or cylinders whose shafts are parallel, having teeth across face. Teeth can be straight, helical or skew or herring bone.

Staggered Tooth Gears—(Fig. 224). Made up of two or more spur or spiral gears; teeth set so that teeth and spaces break joints instead of presenting a continuous pull.

Worm Gears.—(Fig. 225). Spur gears with teeth cut on angle to be driven by a worm. Teeth are usually cut out with a hob to fit the worm.

Gear Teeth—(Fig. 226). The projections which, meshing together, transmit a positive motion. The involute curve tooth is now almost universal. The older form has a 14½ degree pressure angle but some are using a shorter tooth, known as a "stub" tooth, with 20 degrees pressure angle. An involute tooth rack has straight sides to the teeth.

Gears, Pitch of—*Chordal,* distance from center of one tooth to center of next in a direct line.

Circular, distance from center of one tooth to center of next along the pitch line.

Diametral, number of teeth per inch of diameter.

Geneva Stop Motion—A device which gives a positive but intermittent motion to the driven wheel, but prevents its moving in either direction without the driver. The driver may have one tooth or a number if desired.

German Silver.—An alloy of copper 60 parts, zinc 20 parts, nickel 20 parts.

Gib—(Fig. 228). A piece located alongside a sliding member to take up wear.

Gib and Key—(Fig. 227). A device used in railroad and steam engine work to hold rod straps and adjust brasses.

Gland—A cylindrical piece enveloping a stem and used in a stuffing-box to make a tight joint.

Green Sand Mold—See Mold.

GRINDING MACHINES

Grinder, Disk—(Fig. 231). A grinding machine having steel disks which are covered with emery cloth. Some disks have spiral grooves to give cushions under the emery cloth.

Grinder, Cutter—(Fig. 229). A machine for grinding formed milling cutters, reamers, and similar tools.

Grinder, Cylinder—(Fig. 230). A machine designed especially for grinding automobile or other engine cylinders.

Grinder, Internal—A machine specially adapted for grinding holes.

Grinder, Plain—A machine for plain cylindrical grinding.

Grinder, Surface—(Fig. 232). A machine for grinding flat surfaces.

Grinder, Tool—(Fig. 233). A machine for grinding lathe, planer, and similar tools.

Grinder, Universal—(Fig. 234). A machine which can be used on a variety of work such as cylindrical grinding, cutter grinding, etc.

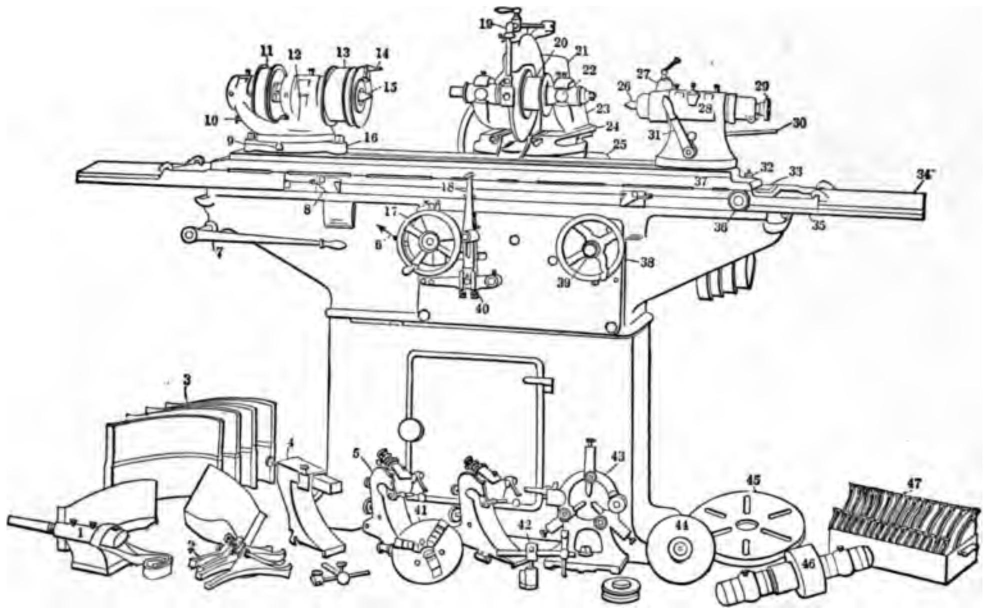
Grinder, Vertical—(Fig. 235). A machine in which the grinding wheel is carried on a vertical spindle.

Grinder, Wet—Any grinding machine which provides for the use of water or any cooling liquid on the work.

Grinding Wheel—(Figs. 236–240). A wheel used for grinding. Common types of grinding wheels made of emery, corundum, corborundum and alundum, are the disk, ring, saucer, cup, and cylinder. Disk and ring wheels are used on the periphery; saucer wheels on the thin edge; cup and cylinder wheels on the end. The latter are commonly used for surface grinding.

FIG. 234.

Grinding Machine—Parts of



1. Internal grinding fixture.
2. Water guard supports.
3. Water guards.
4. Plain back rests.
5. Universal back rest.
6. Automatic cross-feed pawl.
7. Starting and stopping lever.
8. Table-reversing dogs.
9. Headstock index finger.
10. Live spindle-locking pin.
11. Live spindle driving pulley.
12. Headstock.
13. Dead center pulley.
14. Work driving arm and pin.
15. Headstock center
16. Headstock base
17. Cross-feed hand wheel.
18. Reversing lever.
19. Water piping
20. Wheel-driving pulley.
21. Wheel guards.
22. Spindle box.
23. Wheel stand.
24. Wheel-stand platen.
25. Wheel stand slide.
26. Footstock center.
27. Diamond tool holder.
28. Footstock
29. Tension adjusting knob.
30. Quick-adjusting lever.
31. Clamping lever.
32. Clamping bolt.
33. Table scale.
34. Bed water guard.
35. Sliding table.
36. Swivel table knob.
37. Swivel table.
38. Hand wheel.
39. Table travel control.
40. Automatic cross feed.
41. Universal chuck.
42. Tooth rest.
43. Center rest.
44. Face-grinding chuck.
45. Face plate.
46. Internal grinding counter.
47. Work-driving dogs.

Cup—(Fig. 236).
Cylinder—(Fig. 237).
Disk—(Fig. 238).
Ring—(Fig. 239).
Saucer or Dish—(Fig. 240).

Grinding Wheel Dresser—(Fig. 241). A tool consisting of pointed or corrugated disks of hard metal which really break or pry off small particles of the grinding wheel when held against its rapidly revolving surface.

Gripe—Local name for machine clamp.

Ground joint—A joint finished by grinding the two parts together with emery and oil or by other abrasives.

Ground—A connection between the electric circuit and the earth.

Gudgeon—A local name for a trunnion or bearing which projects from a piece as a cannon.

Guide Liner—(Fig. 242). A tool for use in locomotive work for lining up guides and cross heads.

H

Half Nut—A nut which is split lengthwise. Sometimes half is used and rides on screw, in others both halves clamp around screw as in the half nut of a lathe carriage.

HAMMERS

Hammer, Machinists'—(Figs. 243–247). The common types of machinists' hammers are the ball peen, straight peen, and cross peen, as shown. The so-called engineer's and the riveting hammers have cross peens.

Ball Peen—(Fig. 243).
Cross Peen—(Fig. 244).
Engineers'—(Fig. 245).
Riveting—(Fig. 246).
Straight Peen—(Fig. 247).

Bumping or Horning Hammer—A hammer used for closing seams on large cans, buckets, etc.

Drop Hammer—(Fig. 248). A machine in which a hammer head or "monkey" or "drop" is raised by hand or power and falls by gravity. Sometimes raised by a board attached to top of hammer head and running between pulleys. Others use a belt.

Helve Hammer—(Fig. 249). A power hammer in which there is an arm pivoted in the center and power applied at the back end while the hammer is at the other and strikes the work on an anvil.

Lever Trip Hammer.

Spring Hammer—(Fig. 250). A comparatively small hammer giving a great variety in the force of blow. This is controlled by pressure of foot on lever.

Steam Hammer—(Fig. 251). A power hammer in which the hammer head is forced down on the work by steam in a cylinder.

Hand Wheels, Clutched—A hand wheel connected to shaft by a clutch which can be thrown out by a knob or otherwise so that accidental movement of wheel will not disturb setting. Used on milling machines and similar places.

Hanger, Drop—(Fig. 252). A shaft hanger to be fastened to ceiling with bearing held in lower end.

Hanger, Post—(Fig. 253). A shafting hanger for fastening to posts or other vertical structures.

Hardie—(Fig. 254). A blacksmith's cutting chisel which fits a hole in the anvil and forms the lower tool in cutting off work.

Harp—A local name given to the apron or swivel of a planer tool block.

Harveyizing—The surface hardening of steel armor plates by using a bed of charcoal over the work and then gas turned on so it will soak in from the top. Not adapted to small work.

Hindley Worm—See Worm.

Hoist, Chain—A hoist with chain passing through pulley block used for hoisting.

Holder, Drill—A device for holding drill stationary while work is revolved by lathe chuck, or face place. Not a drill chuck.

Hook, Twin or Sister—A double crane hook which resembles an anchor and allows load to be carried on either side.

Hub—A master punch used in making jewelry dies for fancy embossing, and various forms to which articles of gold and silver are to be struck.

Hunting Tooth—An extra tooth in a wheel to give it one more tooth than its mate in order to prevent the same teeth from meshing together all the time.

I

Idler or Idler Pulley—See Pulley, Idler.

Incandescent—A white heat. In an electric lamp, those having a filament of some kind which is heated by the passage of electric current, while enclosed in a bulb from which the air has been exhausted.

Indexing, Compound—Indexing, as in milling machine work, by the combination of two settings of the index. This method uses two rows of holes and adds or subtracts the numbers as the case demands.

Indexing, Differential—Indexing with the index plate geared to the spindle, thus giving a differential motion that allows the indexing to be done with one circle of holes and with the index crank turned in the same direction as in plain indexing.

Indexing, Direct—Indexing work by the direct use of index plates having the required number of holes.

Indicator, Lathe Test—(Figs. 255–256). An instrument for detecting very small variations in the truth of revolving work. Made with a system of levers which multiply the error many times and indicate the error by a long pointer or on a dial which resembles a watch. Used for setting work in a lathe either between centers or on a face plate.

Induction Motor—A motor which runs by the magnetic pull through the air without contact. Usually a constant-speed motor.

J

Jack, Hydraulic—(Fig. 257). Device for raising weight or exerting pressure by pumping oil or other liquid under a piston or ram.

Jack, Leveling—(Fig. 258). Small jacks (usually screw jacks) for leveling and holding work on planer beds and similar places. Practically adjustable blocking.

Jack, Screw—(Fig. 259). A device for elevating weights by means of a screw.

Jack Shaft—See Shaft, Jack.

Jam Plates—An old name for screw plates and in many cases a true one as the thread was jammed instead of cut.

Jig, Drill—A device for holding work while drilling, having bushings through which the drill is guided so that the holes are correctly located in the piece. Milling and planing jigs (commonly called fixtures) hold work while it is machined in the milling machine and planer. Parts produced in jigs and fixtures are interchangeable.

Jig, String—A jig to hold a number of pieces to be planed or milled.

Joint, Butt—(Fig. 260). A joint where the edges to be joined are "butted" together without lap. Usually applied to riveted joints altogether some welding is done that way. The outside pieces are called the "welts."

Joint, Lap—(Fig. 261). A joint in which the edges lap on each other.

Joint, Universal—(Fig. 262). A shaft connection which allows freedom in any direction and still conveys a positive motion. Most of them can transmit power through any angle up to 45 degrees.

Journal Box—The part of a bearing in which the shaft revolves.

K

Kerf—The slot or passageway cut by a saw.

KEYS

Key—A piece used to fasten any hollow object to a shaft or rod. Usually applied to fastening pulleys and fly-wheels to shafts; or locomotive driving wheels to their axles. Keys may be square, rectangular, round or other shape and fasten in any way. Are usually rectangular and run lengthwise of shaft.

Barth Key—(Fig. 263). This key was invented several years ago by Carl G. Barth. It is simply a rectangular key with one-half of both sides beveled off at 45 degrees. The key need not fit tightly, as the pressure tends to drive it better into its seat. As a feather key this key has been used in a great many cases to replace rectangular feather keys which have given trouble. It has also been used to replace keys which were sheared off under heavy load.

Center Key—(Fig. 264). Not a key in the usual sense but a flat piece of steel, with tapered sides, for removing taper shank drills from drill spindle or similar work.

Dive Key—A key which "dives" or is forced down to disengage the keyway of one gear and be moved to another gear. Used in change feed-gear boxes on machine tool.

Lewis Key—(Fig. 265). A key invented by Wilfred Lewis about twenty years ago. Its position is such that it is subjected to compression only.

Round End Key—(Fig. 266). A key which is fitted into a shaft by end milling a seat into which the key is secured. Where a key of some length is fixed in the shaft and a member arranged to slide thereon it is called a feather or feather key.

Taper Key—(Fig. 267). A key made taper to tighten as it is driven in. The taper is commonly from $\frac{1}{8}$ to $\frac{3}{16}$ inch per foot. It is made both with and without a head.

Woodruff Key—(Fig. 268). A semi-circular key used in various kinds of shafts, studs, etc. It is fitted in place by merely sinking a seat with a shank mill such as the Whitney cutter.

Key Seater—A machine for cutting keyways in shafts or hubs of pulleys or gears.

Keyway—A groove, usually square or rectangular, in which the key is driven or in which a "feather" slides. The groove in both the shaft and piece which is to be fastened to it, or guided on it, is called a keyway.

Knurling—See Nurling.

L

Land—The space between flutes or grooves in drills, taps, reamers or other tools.

Lap—Applied to seams which lap each other. To the distance a valve must move before opening its port when valve is central on seat. To a tool usually consisting of lead, iron, or copper charged with abrasive for fine grinding. (See Lap, Lead.)

Lap, Lead—(Fig. 269). Usually a bar of lead or covered with lead, a trifle smaller than the hole to be ground. Emery or some fine abrasive is used which gives a fine surface. Laps are sometimes held in the hand or are run in a machine and the work held stationary. Also consists at times of a lead-covered disk, revolving horizontally, which is used for grinding flat surfaces. Very similar in action to a potter's wheel.

LATHE

Bench Lathe—(Fig. 270). A small lathe mounted on the bench.

Double Spindle Lathe—A lathe having two working spindles, so located that one gives a much larger swing than the other, and both can be used to advantage. Especially good for repair shops.

Engine Lathe—(Fig. 271). The usual form of iron-turning lathe having a lead screw, power feed, etc.

Engine Lathe Apron—(Fig. 271 A). The part of the lathe carriage containing the feed gearing.

Extension Lathe—A lathe made so that upper part of bed can be moved on the lower to increase distance between centers. When bed is made longer, there is a gap near head, increasing the swing for face-plate work.

Fox Lathe—(Fig. 272). A lathe for brass workers having a fox or chasing bar instead of a lead screw. Has cross-feeding tail stock or turret as desired. Turning is usually done with a removable slide rest.

Gap Lathe—A lathe having a U-shaped gap in front of head stock to increase swing for face-plate work.

Gun Lathe—A lathe especially for boring and turning cannon and rapid fire guns.

Ingot Lathe—A lathe especially for boring, turning, and cutting off steel ingots.

Precision Lathe—A bench lathe made especially for small and very accurate die, jig, or model work.

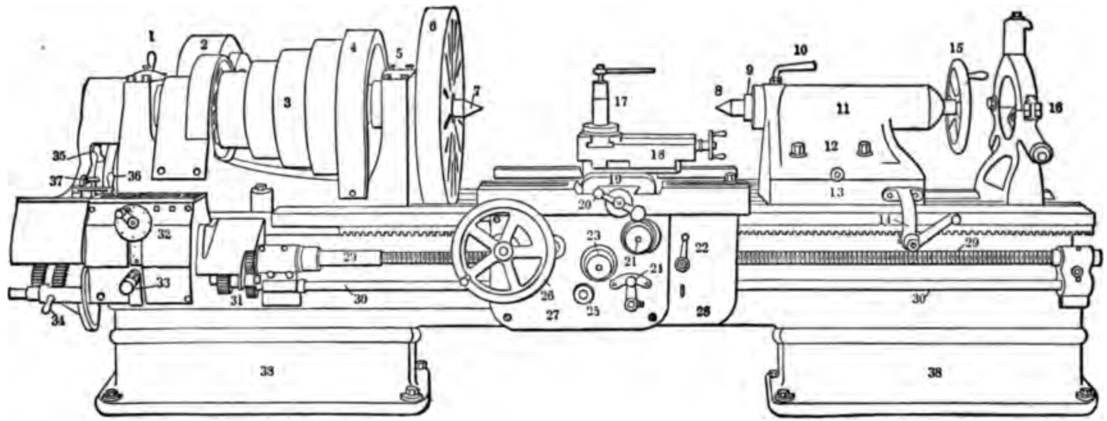


FIG. 271.

Lathe, Engine—Parts of

1. Rear bearing.
2. Back-gear case.
3. Cone pulley.
4. Face-gear guard.
5. Front bearing.
6. Face plate.
7. Live center.
8. Dead center.
9. Tail spindle.
10. Tail-spindle lock.
11. Tailstock slide.
12. Locking bolts.
13. Tailstock base.
14. Tailstock pinion.
15. Tailstock hand wheel.
16. Steady rest.
17. Tool post.
18. Compound rest.
19. Cross-slide.
20. Cross-feed screw.
21. Cross-power feed.
22. Half-nut handle.
23. Regular power feed.
24. Feed reverse.
25. Gear stud.
26. Hand feed.
27. Front apron.
28. Rear apron.
29. Lead screw.
30. Feed rod.
31. Feed gears.
32. Feed box.
33. Change-gear handle.
34. Compound gears.
35. Change-gear handle.
36. Change-gear handle.
37. Change-gear handle.
38. Bed.

Projectile Lathe—A heavy lathe for turning up projectiles. Sometimes has attachment for pointing them.

Pulley Lathe—A lathe especially designed for turning pulleys, can turn them crowning or straight.

Roll Turning Lathe—A lathe especially for turning rolling mill, steel mill, and calendar rolls.

Screw Cutting Lathe—A lathe having a lead screw and change gears for cutting threads.

Shafting Lathe—A lathe especially designed for turning long shafts or similar work.

Speed Lathe—A plain lathe with no mechanically actuated carriage or attachments.

Spinning Lathe—A lathe for forming sheet metal into various hollow shapes, all circular. Done by forcing against a form of some kind (with a single round ended tool) while it is revolving.

Stone Turning Lathe—A lathe especially designed for turning stone columns or similar shapes.

Turret Lathe—(Fig. 273). A lathe having a multiple tool holder which revolves. This is the turret. Usually takes place of tail or foot stock but not always. Usually has automatic devices for turning turret and sometimes for feeding tools against work.

Vertical Lathe—A name given one type of Bullard boring mill on account of a side head which acts very much like a lathe carriage and does a large variety of work that would ordinarily be done on the face-plate of a lathe.

Watchmaker's Lathe—A very small precision lathe.

Lead—The advance made by one turn of a screw. Often confused with pitch of thread but not the same unless in the case of a single thread. With a double thread the lead is twice as much as the pitch.

Level—Instrument with a glass tube or vial containing a liquid which does not quite fill it. The tube is usually ground on an arc so that bubble can easily get to the center. Alcohol is generally used as it does not freeze at ordinary temperatures.

Level, Engineers'—Level mounted on tripod and having telescope for leveling distant objects.

Level, Pocket—Small level to be carried in pocket.

Level, Quartering—A tool for testing driving wheels to see if crank-pins are set 90 degrees apart. The level has a forked end and with the angles shown. Placing this on the crank-pin and lining the edge with the center of axle should bring the bubble of level in the center. If the same result is obtained on the other wheel, the crank-pins are 90 degrees apart.

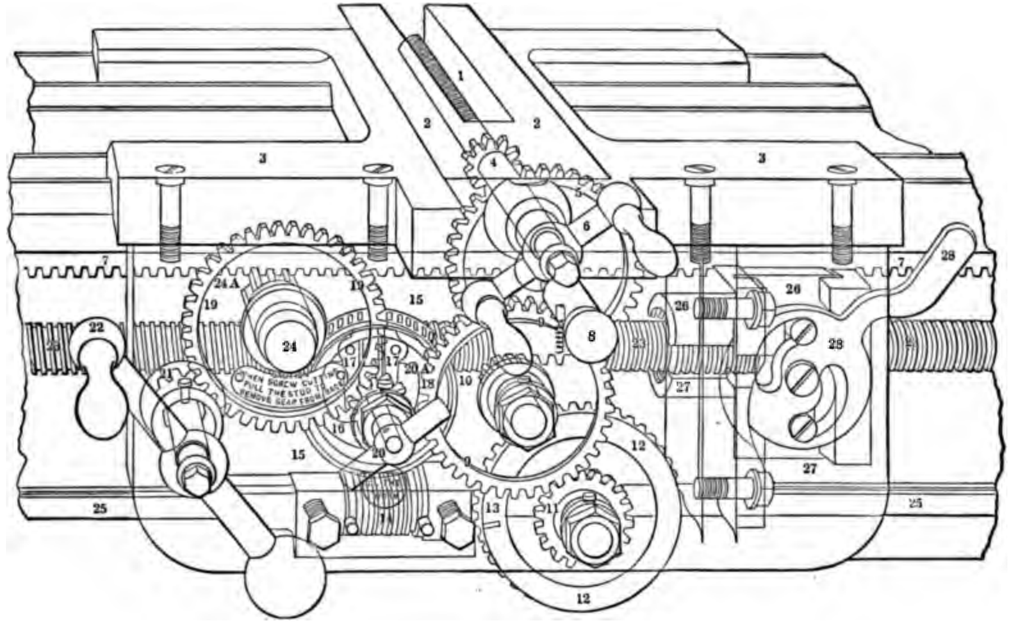


FIG. 271 A. **Lathe Apron, Reed—Parts of**

1. Cross-feed screw.
2. Cross-slides.
3. Wing of saddle.
4. Cross-feed pinion.
5. Cross-feed gear.
6. Cross-feed handle.
7. Rack.
8. Power cross-feed and control.
9. Gear in train.
10. Pinion for cross-feed.
11. Main driving pinion.
12. Bevel gear.
13. Bevel pinion.
14. Feed-worm.
15. Feed-worm wheel.
16. Clutch ring.
17. Clutch levers.
18. Pinion.
19. Gear in train.
20. Feed-clutch handle.

20A. Clutch spreader.

21. Hand pinion.
22. Carriage handle.
23. Lead screw.
24. Rack pinion knob.

24A. Rack pinion.

25. Feed rod.
26. Upper-half nut.
27. Lower-half nut.
28. Half-nut cam.

NOTE:—Cross-feed is from bevel pinion 13, through gears 12, 11, 9, 10, and 4. Regular feed is through worm 14, worm wheel 15, clutch 16, pinion 18, gears 19 and 24 A. Hand movement is through handle 22, pinion 21, 19, and 24 A.

Lever—An arm pivoted or bearing on points called fulcrums. Levers are divided into three classes as shown. The first has fulcrum or bearing point between power and weight, the second has weight between power and fulcrum and the third has power between weight and fulcrum.

Line Shaft—See Shaft, Line.

Liner—A piece for separating pieces a desired distance; also called shim.

Live Center—See Center, Live.

Loam Mold—See Mold, Loam.

M

Machinists' Clamp—See Clamp, Machinists'.

Magnet, Electro—A magnet consisting of a bar or core of iron or soft steel inside of coils of insulated wire which carry electric current. This passing of current through the wires makes the core magnetic while it is passing.

Magnet, Permanent—A magnet made for a piece of hardened steel which retains its magnetism for a long time after being thoroughly magnetized.

Mandrel—(Fig. 276). A bar or shaft on which work is held to be turned or otherwise operated on. It is usually made with a taper of about .01 inch per foot to be driven into the work. Often called an arbor or work arbor.

Mandrel, Centering—A mandrel which is used for centering the work but not for driving it. Centering mandrels are usually made to fit the lathe spindle or face plate. Also called centering arbors.

Mandrel, Expanding—(Fig. 277). A mandrel which can be expanded or contracted to hold work of varying sizes, usually within rather small limits. Three styles are shown.

Marking Machine—A machine for stamping trade-marks, patent dates, etc., on cutlery, gun barrels, etc. Stamps are usually on rolls and rolled into work.

Master Die—See Die, Master.

Master Plate—(Fig. 278). See Plate, Master.

Master Tap—See Tap, Master.

Match Board—The board used to hold patterns, half on each side, while being molded on some types of molding machines.

Measuring Machine—A machine which is practically a large bench caliper of any desired form to measure work such as taps, reamers, gages, etc.

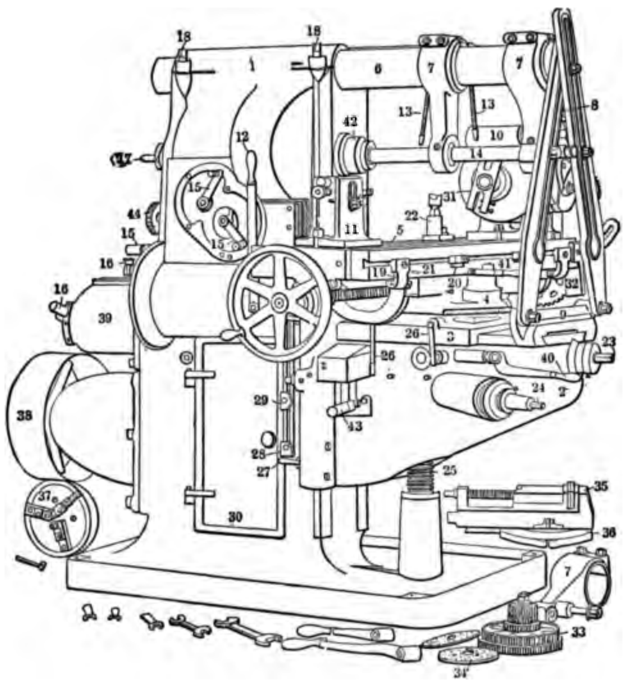


FIG. 283.

Milling Machine—Universal—Parts of

1. Column.
2. Knee.
3. Saddle.
4. Swivel carriage.
5. Work table.
6. Over arm.
7. Arm brackets (arbor supports).
8. Arm braces (harness).
9. Knee clamp (for arm braces).
10. Spiral dividing head.
11. Tailstock.
12. Starting lever.
13. Oil tubes.
14. Cutter arbor.
15. Speed-changing lever.
16. Feed-changing lever.
17. Draw-in rod for arbor.
18. Arm-clamp screws.
19. Table stops.
20. Table-feed trip block.
21. Fixed table-feed trips.
22. Steady rest.
23. Cross-feed screw.
24. Elevating shaft.
25. Elevating screw (telescopic).
26. Saddle-clamp levers.
27. Knee-clamp levers.
28. Fixed vertical feed trip.
29. Vertical feed-trip blocks.
30. Door.
31. Dog driver.
32. Change-gear bracket.
33. Change gears.
34. Index plates.
35. Vise.
36. Swivel base.
37. Universal chuck.
38. Driving pulley.
39. Feed box.
40. Cross and vertical feed handle.
41. Table-feed handle.
42. Clutch-drive collar.
43. Interlocking lever to prevent the engagement of more than one feed at a time.

Measuring Rod—(Fig. 279). Steel rods of standard length for measuring.

Milling Cutter—See Cutter, Milling.

Milling Machine—A machine in which the operating tool is a revolving cutter. It has a table for holding the work and moving it against the cutter.

Milling Machine, Hand—(Fig. 280). A milling machine in which the work is fed by hand instead of power, usually by a lever feed.

Milling Machine, Knee Type—A milling machine having the work table supported on a knee which moves vertically on the face of the main frame or column.

Milling Machine, Lincoln—(Fig. 281). A type of milling machine in which the milling spindle can be moved vertically and the work is moved horizontally on the platen or table.

Milling Machine, Manufacturing—A name given to milling machines of the planer type.

Milling Machine, Plain—A milling machine of the knee type in which the work table does not swivel on the knee.

Milling Machine, Planer or Slab Type—(Fig. 282). A milling machine built on the lines of a planer but with one or more milling cutter supported by the housings and cross rail, so as to operate on the work as the table is fed along under the cutters.

Milling Machine, Universal—(Fig. 283). A milling machine of the knee type having a swiveling table arranged with feeds by which all classes of plane, circular, helical, index and other milling may be done. It is equipped with dividing head, centers, chucks, etc.

Milling Machine, Vertical—(Fig. 284). A milling machine in which the cutter is carried on a vertical spindle.

Miter—A bevel of 45 degrees.

Mold—The form in which a casting is made. The mold consists of the cope and the drag or nowel, with the sand inside molded to pattern and ready to pour.

Mold Board—The board used to put over a flask to keep sand from falling when being handled and sometimes used to clamp on when fastening molds together.

Mold, Green Sand—A mold made of sand that is moistened for molding and that is not dried out or baked before pouring.

Mold, Loam—A mold made with a mixture of coarse sand and loam. This is made into a sort of plaster which is spread over bricks or other frame work to make the mold. It is used on large castings to produce a smoother finish than can be had with green sand.

Mufflex—A name given to ovens or furnaces for heating steel where the flame does not strike the work directly. The steel is placed

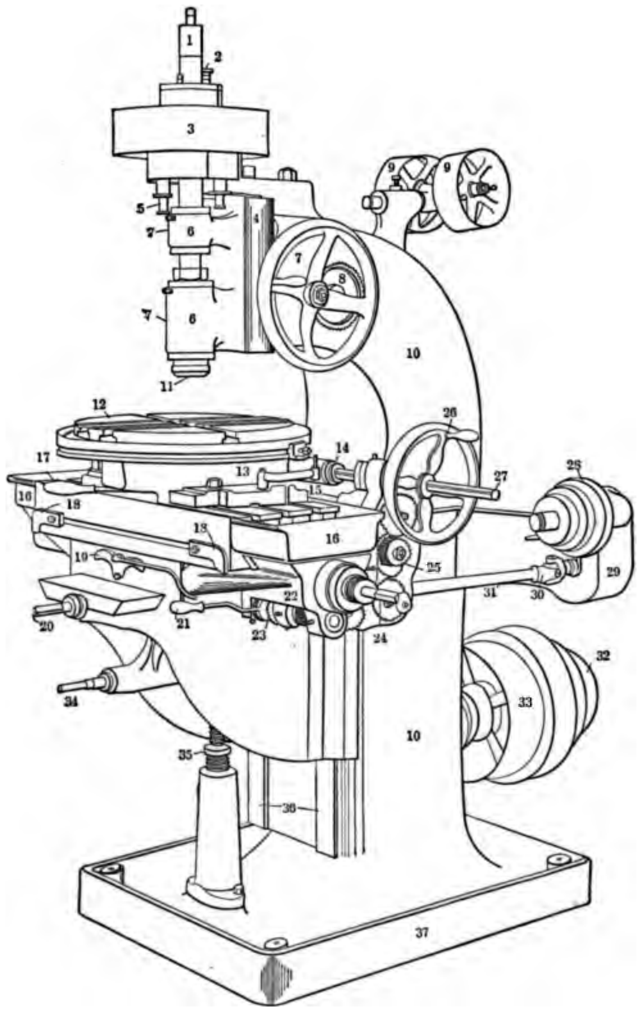


FIG. 284.

Milling Machine—Vertical—Parts of

1. Spindle drawbar cap.
2. Back-gear pull pin.
3. Spindle-driving pulley.
4. Spindle head.
5. Back-gear sliding pinion and steam gear.
6. Spindle upper box.
6. Spindle lower box.
7. Spindle head bearing.
8. Head-feed gear.
9. Idler pulleys.
10. Standard.
11. Spindle.
12. Rotary attachment.
13. Rotary attachment feed-trip dog and lever.
14. Rotary attachment feed clutch
15. Rotary attachment base.
16. Table and table oil pans.
17. Rotary attachment binder.
18. Feed-trip dogs, right and left.
19. Feed-trip plate.
20. Cross-feed screw.
21. Feed-clutch lever.
22. Carriage.
23. Feed clutch.
24. Table-feed screw.
25. Rotary attachment feed gears
26. Rotary attachment hand wheel.
27. Rotary attachment feed rod.
28. Feed-driving cone.
29. Feed bracket.
30. Universal joint.
31. Telescopic feed shaft.
32. Driving cone.
33. Driving pulley.
34. Knee-elevating shaft.
35. Knee-elevating telescopic screw.
36. Face of standaid.
37. Basc.

in a hollow box or fixed portion of the furnace which is usually made of fire clay and the heat circulates around it.

Muley Belt—See Belt, Muley.

Muley Shaft—See Shaft, Muley.

N

Necking Tool—A tool made for turning a groove or neck in a piece of work.

Nose—This is the term applied to the end of a tool or piece of machinery which projects beyond the rest. As the cutting point of a lathe tool, the projecting end of a spindle as in a lathe or milling machine, whether threaded or not.

Nowel—The lower part of a molders flask; also called drag.

Nurl—A hardened steel wheel or disk with corrugations or any design on its edge. The tool used in nurling.

Nurling—The rolling of depressions of various kinds into metal by the use of revolving hardened steel wheels pressed against the work. The design on the nurl will be produced on the work. Generally used to give a roughened surface for turning a nut or screw by hand. Sometimes called milling.

Nurling Tool—(Fig. 285). A device for roughing or checking the outside of turned work so it can be readily grasped by hand. The tool is a wheel with the desired markings cut in the edge and hardened. It is forced against the work and actually forces the metal up into the depressions in the wheel. Most nurls are held in the end of a hand tool but for heavy nurling they are made to go in the tool post as shown.

Nut—A piece of metal with an internal thread to be screwed on a threaded rod or bolt. Sometimes called a burr.

Nut, Cold Punched—A nut punched from flat bar stock. The hole is usually reamed to size before tapping.

Nut, Hot Pressed—A nut formed hot in a forging machine.

Nut, Castellated or Castle—(Fig. 286). A nut with slot across the face to admit a cotter pin for locking in place.

Nut Machine—A machine for cutting, drilling and tapping nuts from a bar or rod.

Nut Tapper—A machine for tapping hole in nuts.

Thumb Nut—(Fig. 287). A round nut, usually nurled to give a good grip for thumb and fore finger.

Wing Nut—(Fig. 288). A nut operated by hand and very commonly used where a light and quick clamping action is required.

Nuts—See Bolts.

O

Ohm—The unit of electrical resistance. One volt will force one ampere through a resistance of one ohm.

Oval—A geometrical figure which is continuously curved but not round, as a circle which has been more or less flattened.

Old Man—(Fig. 289). The shop term for a brace or support for a ratchet drill or similar tool.

P

Pawl—A hinged piece which engages teeth in a gear, rack or ratchet for moving it or for arresting its motion. Sometimes used to designate a piece such as a reversing dog on a planer or milling machine.

Peen—The end of a hammer opposite its regular face. To stretch by hammering.

Peening—The stretching of metal by hammering or rolling the surface. Used to stretch babbitt to fit tightly in a bearing, to straighten bars by stretching the short or concave side, etc.

Pickle—An acid solution for softening the scale and removing sand from castings. A solution of from 3 to 4 parts of water to 1 part of sulphuric or hydrofluoric acid is good for iron. For brass, use 5 parts water to 1 of nitric acid. For forgings use 1 part sulphuric to 25 parts boiling water. Rinse in boiling water to prevent rust.

Pin, Collar—(Fig. 290). A collar pin is driven tight into a machine frame or member and adapted to carry a roll, gear, or other part at the outer end. It differs from the collar stud in not having a thread at the inner end. When drilled through the end for a cotter pin it is known as a fulcrum pin, as it is then especially suited for carrying rocker arm.

Pin, Dowel—A pin used to locate one piece in correct position on another. They are usually made straight or a plain taper and fitted in reamed into reamed holes.

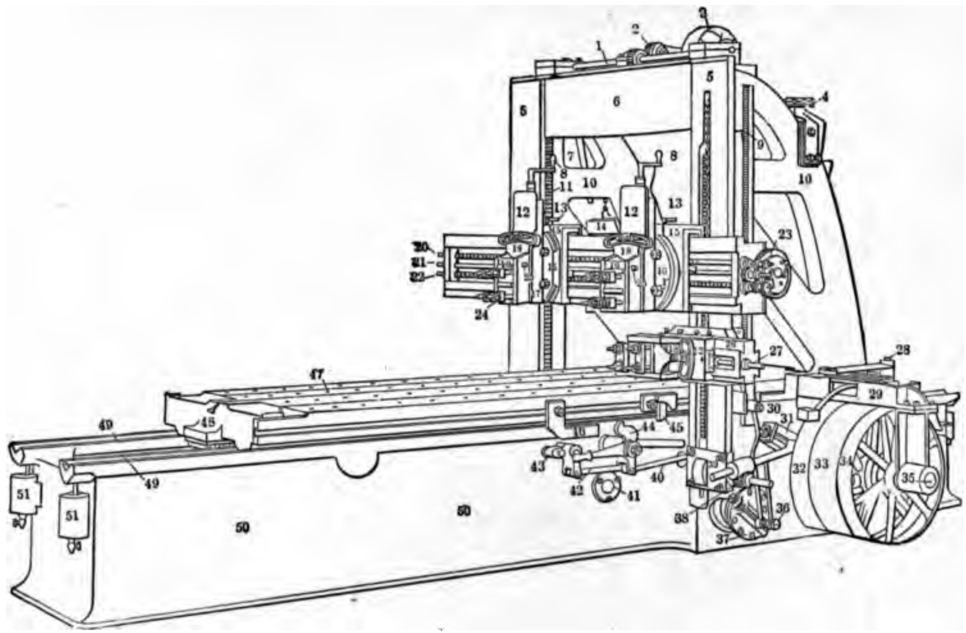
Pin, Dowel, Screw—A dowel pin which is screwed into place.

Pin, Taper—(Fig. 291). A taper pin for dowels and other purposes are regularly manufactured with a taper of $\frac{1}{4}$ inch to the foot and from $\frac{3}{4}$ to 6 inches long, the diameters at the large end of the sizes in the series ranging from about $\frac{5}{32}$ to $\frac{23}{32}$ inch. The reamers for these pins are so proportioned that each size "overlaps" the next smaller size by about $\frac{1}{2}$ inch.

Pitch—The distance from the center of one screw thread, or gear tooth or serration of any kind to the center of the next. In screws with a single thread the pitch is the same as the lead but not otherwise.

FIG. 293.

Planer—Parts of



1. Shaft for raising cross-rail.
2. Gears for raising cross-rail.
3. Pulley drive for raising cross-rail.
4. Chain for counterweighing the cross-rail.
5. Face of uprights.
6. Tie piece between uprights.
7. Handle controlling.
8. Crank handle for raising tool block.
9. Rack for moving feed screw in cross-rail.
10. Upright or housing.
11. Screw for elevating cross-rail.
12. Tool slide.
13. Screw to clamp saddle to cross-rail.
14. Counterweight for left side of cross-rail.
15. Saddle.
16. Swivel.
17. Clamping bolt.
18. Clapper box.
19. Clapper block.
20. Feed screw for left-hand head.
21. Vertical feed rod.
22. Feed screw for right-hand head.
23. Feed mechanism on end of cross-rail.
24. Tool-holding straps.
25. Clapper block pin.
26. Side head.
27. Side head for feed screw.
28. Belt shifter.
29. Drive-pulley support.
30. Connection to feed rack.
31. Regulator for vertical feed.
32. Forward driving pulley.
33. Loose pulley.
34. Return driving pulley.
35. Driving shaft.
36. Regulator cross-feed.
37. Cross-feed drive.
38. Vertical feed pinion.
39. Vertical feed rod.
40. Rod to belt shifter for reversing.
41. Bull or driving-wheel shaft.
42. Connections to safety lock.
43. Lock to prevent table being moved.
44. Reversing latch or trip.
45. Forward stop dog.
46. Backward stop dog.
47. Platen or table.
48. Rack under platen.
49. Ways or V's.
50. Bed.
51. Oil reservoirs.

Pillow Block—(Fig. 292). A low shaft bearing, resting on foundations, or floors or other supports.

Planchet—A blank piece of metal punched out of a sheet before being finished by further work. Such as the blanks from which coins are made.

Planer—(Fig. 293). A machine for producing plane surfaces on metals. The work is held on table or platen which runs back and forth under the tool which is stationary.

Planer Centers—(Fig. 294). A pair of index centers to hold work for planing. Similar to plain milling machine centers.

Planer, Open Side—A planer with only one upright or housing, supporting an overhanging arm which takes the place of the usual cross rail. Useful in planing work too wide to go in the ordinary planer.

Planer, Radius—A planer adapted for planing parts of circles such as links for locomotive or stationary engine valve motion.

Planer, Frog and Switch—A very heavy type of planer with low housings and a strong cross rail, designed especially for planing frogs and switches in railroad work.

Planer, Plate—A planer designed to plane the edges of wide plates. The plate is clamped rigidily in position and a tool head travels along the bed carrying the planing tool.

Planer, Rotary—A machine in which the work table is fed past a large rotary cutter on a horizontal spindle. It is really a large milling machine.

Planer, Sellers—The name given to any planer in which the table is driven by a worm which runs in the rack instead of the usual bull wheel. The work lays at an angle so as to bring the thread of the worm parallel with the teeth of the rack. First built by William Sellers.

Planer Tools—See Tools, Planer.

Planer, Traveling Head—A planer in which work is stationary and tool moves over it.

Planishing—The finishing of sheet metal by hammering with smooth-faced hammers of their equivalents.

Plate, Master—A steel plate serving as a model by which holes in jigs, fixtures, and other tools are accurately located for boring. In the illustration the piece to be bored is shown dowelled to the master plate which is mounted on the face plate of the lathe. In the master plate there are as many holes as are to be bored in the work, and the center distances are correct. The plate is located on a center plug fitting the lathe spindle, and after a given hole is bored in the work, the master plate and work are shifted and relocated with the center plug in the next hole in the plate and the corresponding

hole in the work is then bored out. This is one of the most accurate methods employed by the toolmaker on precision work.

Platen—The part of a machine which holds the work as in a planer, milling machine, or grinder. Usually called the table.

Plumb Bob—A heavy weight, usually of metal, which is suspended by a cord which indicates a line that would run through the center of the earth.

Plumb Bob, Mercury—(Fig. 295). A plumb bob which is filled with mercury to get heavy weight in a small space.

PRESSES

Blanking Press—(Fig. 296). A machine designed for heavy punching or swaging.

Cabbaging Press—A press for compressing loose sheet metal scrap into convenient form for handling and remelting.

Coining Press—(Fig. 297). A press, usually of the toggle type, used in making coins and medals.

Double Acting Press—(Fig. 298). A press with a telescoping ram, or one ram inside the other, each driven by an independent cam, so that one motion follows the other and performs two operations for each revolution of the press.

Embossing Press—A press designed for embossing metal.

Forcing Press—A press for forcing one piece into another, such as a rod brass into a rod.

Forging Press—A press for forging metal by subjecting it to a heavy pressure between dies. Similar to a bull-dozer.

Horning Press—A press for closing the side seams on pieced tinware.

Hydraulic Press—A press operated by hydraulic pressure.

Inclinable Press—(Fig. 299). A press that can be used in a vertical or inclined position.

Pendulum Press—(Fig. 300). A foot press having a lever which swings like a pendulum to operate the ram.

Punch Press—Any press for punching sheet metal.

Screw Press—(Fig. 301). A press in which the pressure is applied by a screw.

Straight-sided Press—A press made with straight sides to give great strength and rigidity for heavy work.

Toggle Press—A press in which the pressure is applied by toggle levers. Coining and embossing presses are usually of this type.

Profiling Machine—A machine having a rotary cutter that can be made to follow outline or pattern in shaping small parts of machines. Practically a vertical milling machine.

Protractor—An instrument in the form of a half circle and with its circular edge graduated into degrees.

Protractor, Bevel—(Fig. 302). A protractor having a pivoted arm for laying off angles.

Pull-pin—A means of locking or unlocking two parts of machinery. Sometimes slides gears in or out of mesh and at others operates a sliding key which engages any desired gear of a number on stud.

Pulley—A device of wood or metal with a hole through its center for a shaft and its rim designed to carry a belt which may be flat or of any other shape.

Pulley, Gallow or Guide—A loose pulley mounted in movable frames to guide and tighten belts.

Pulley, Idler—A pulley running loose on a shaft and driving no machinery, merely guiding the belt. Practically same as a "loose pulley."

Pulley, Loose—A pulley running loosely on shaft doing no work. Carries belt when not driving tight (or fast, or working) pulley. Used on countershafts, planers, grinders, etc., where machine is idle part of time. Belt is then on the loose pulley, but when shifted to tight pulley the machine starts up. (See Belt Shifter, Friction Clutch.)

Punching—A piece cut out of sheet stock by punch and die; the same as blank.

Punch, Belt—A hollow, round or elliptical punch for cutting holes for belt lacing.

Q

Quadrant—Technically, a quarter of a circle, but is often applied to any segment or part of a circle. A usual name given to the swinging plate carrying the change gears at the end of the lathe.

Quick Return—A mechanism employed in various machine tools to give a table, ram or other member a rapid movement during the return or non-cutting stroke.

Quill—A hollow shaft which may be stationary and carry a revolving shaft as in a drill or may revolve on a stationary shaft as in the back gears or a lathe. In some cases the quill and shaft may revolve together under certain conditions.

R

Rack—(Fig. 303). A strip cut with teeth so that a gear can mesh with it to convert rotary into reciprocating motion or vice versa.

Rack Cutter—A machine which is designed to cut the teeth in a rack at regular intervals. The cutting tool is usually a rotary milling cutter, although a formed planing tool is sometimes used.

Ratchet and Pawl—(Fig. 304). A gear with triangular-shaped teeth adapted to be engaged by a pawl which either imparts intermittent motion to the ratchet or else locks it against backward movement when operated otherwise.

Recess—A groove below the normal surface of work. On flat work a groove to allow tool to run into as a planer or a slide to run over as a cross-head on a guide. In boring a groove inside a hole. If long it is often called a chamber.

Relief or Relieving—The removing of, or the amount removed to reduce friction back of cutting edge of a drill, reamer, tap, etc. Also applied to other than cutting tools. (See "backing off.")

REAMERS

Reamer—A tool to enlarge a hole already existing, whether a cast or cored hole or one made by a drill or boring bar. Reamers are of many kinds and shape as indicated below. Usually a reamer gives the finishing touch to a hole.

Ball Reamer—Usually a fluted or rose reamer for making the female portion of a ball joint. It is considered advisable to space the teeth irregularly as this tends to prevent chattering.

Bridge Reamer—(Fig. 305). A reamer used by boiler-makers, bridge builders, ship-builders, etc., has a straight body and tapered end. This reamer has a taper shank and can be used in an air drill.

Center Reamer—(Fig. 306). Center reamers, or countersinks for centering the ends of shafts, etc., are usually made 60 degrees included angle.

Chucking Reamer—Chucking reamers are used in turret machines. The plain, fluted type has teeth relieved the whole length; while the rose reamer cuts only on the end as there is no peripheral clearance. Where possible reamers used in the turret should be mounted in floating holders which allow the reamer to play sidewise sufficiently to line up with the hole in the work which may be so drilled or bored as not to run perfectly true prior to the reaming operation.

Fluted—(Fig. 307).

Rose—(Fig. 308).

Chucking Reamer (Three-groove)—(Fig. 309). Spiral fluted chucking reamers with three and four grooves are employed for enlarging cored holes, etc. They are also made with oil passages through them and in this form are adapted to operating in steel.

Flat Reamer—A reamer made of a flat piece of steel. Not much used except on brass work and then usually packed with wooden

strips to fit the hole tightly. Flat reamers are not much used except for taper work.

Half-round Reamer—Used considerably in some classes of work, particularly in small sizes and taper work when taper is slight. Not much used in large sizes. Somewhat resembles the "hog-nose drill" in general appearance except that this is always quite short on cutting edge.

Hand Reamer—Reamers enlarge and finish a hole produced by drilling, boring, etc. The cut should be light for hand reamers and the reamer held straight to avoid ruining the hole. The threaded end reamer has a fine thread to assist in drawing the reamer into the work. The spiral reamer is cut left-hand to prevent its drawing into the hole too rapidly. Reamers are slightly tapered at the point to enable them to enter.

Straight—(Fig. 310).

Spiral—(Fig. 311).

Threaded End—(Fig. 312).

Pipe Reamer (Briggs)—(Fig. 313). Pipe reamers to the Briggs standard taper of $\frac{3}{4}$-inch per foot are used for reaming out work prior to tapping with the pipe tap.

Shell Reamer, Adjustable—(Fig. 314). A shell reamer having adjustable blades for maintaining sizes.

Shell Reamer—(Fig. 315). Shell reamers have taper holes to fit the end of an arbor on which they are held in the chucking machine. They are made with both straight and spiral flutes.

Shell Reamer (Rose)—(Fig. 316). Rose reamers cut on the end only as there is no peripheral clearance. They are very accurate tools for finishing holes. The shell reamers are made with taper holes to fit an arbor for holding them in the turret machine.

Taper Reamer—For finishing taper holes two or more reamers are sometimes used. The roughing reamer is often provided with nicked or stepped teeth to break up the chip. Taper reamers are also made with spiral teeth. Where the taper is slight the spiral should be left-hand to prevent the reamer from drawing in too fast; where the taper is abrupt the teeth, if cut with right-hand spiral, will help hold the reamer to the cut and make the operation more satisfactory.

Finishing—(Fig. 317).

Roughing—(Fig. 318).

Taper Pin Reamer—(Fig. 319). Standard taper pin reamers are made $\frac{1}{4}$-inch taper per foot and each size in the series will overlap the next size smaller by about one-half inch.

Taper Reamer, Locomotive—(Fig. 320). Reamers for locomotive taper pins have a taper of $\frac{1}{16}$ inch per foot.

RESTS

Back or Follow Rest—(Fig. 321). A support for the work which is fastened to the lathe carriage and travels with it, to support the work as nearly behind the cutting tool as possible.

Compound Rest—(Fig. 322). A tool rest having a swiveling base which is usually divided into degrees, so that the tool may be fed at any desired angle.

Hand Rest—(Fig. 323). A support for hand tools while turning in a speed or other lathe.

Rests, Slide—(Fig. 324). Detachable rests capable of being clamped to brass lathe bed at any desired point and usually arranged to give motion to tool in two ways; across the bed to reduce diameter or cut-off, and with the bed for turning. Invented by Henry Maudsley.

Steady Rest—(Fig. 325). A rest or support which is clamped to the lathe bed for supporting slender work being turned.

Rheostat—An adjustable resistance box so that part of the current can be cut out of the motor.

Riddle—A name given to a sieve used in foundries for siftings and for the molds.

Riffle—A name given a small file used by die sinkers and on similar work.

Rivet—(Figs. 326–336). A pin for holding two or more plates or pieces together. A head is formed on one end when made; the other end is upset after the rivet is put in place and draws the riveted members close together.

Bead Head Rivet—(Fig. 326).
Cone Head Rivet—(Fig. 327).
Countersink Head Rivet—(Fig. 328).
Flat Head Rivet—(Fig. 329).
Globe Head Rivet—(Fig. 330).
Machine Head Rivet—(Fig. 331).
Oval Countersink Head Rivet—(Fig. 332).
Round Head Rivet—(Fig. 333).
Truss Head Rivet—(Fig. 334).
Wagon-box Head Rivet—(Fig. 335).
Wheel Head Rivet—(Fig. 336).

Rivet Machine—A machine for making rivets from metal rods.

Roller Bearing—See Bearing, Roller

9

RULES

Rule—A graduated piece, usually of wood or steel and either stiff or flexible, for measuring distances.

Hook Rule—(Fig. 337). A rule with a hook on the end for measuring through pulley holes and in similar places.

Key-seat Rule—(Fig. 338). A special rule for laying out key-seats on shaft or in hubs.

Rule, Shrink—A rule that is graduated to allow for shrinkage in casting. Used by pattern-makers and varies with metal to be cast.

Triangular Rule—A rule which is triangular in form and has graduations on the edges.

Run—A term applied to drilling or reaming when the tool shows a tendency to leave the straight or direct path. Caused by one lip or cutting edge being less sharp than the other, being ground so one lip leads the other, or from uneven hardness of material being drilled.

Running or Sliding Fit—See Fits.

Rust Joint—A joint made by application of cast-iron turnings mixed with sal-ammoniac and sulphur to cause the turnings to rust and become a solid body.

S

Saw, Cold—(Fig. 339). For sawing metal. Circular saws are generally used though not always, band saws being occasionally employed.

Saw, Hack—(Fig. 340). Close-toothed saw for cutting metal. Usually held in a hand frame but power hack saws are now becoming very common in shops.

Scale—A hard surface which forms on metals when they are heated to a high degree as in castings and in hardening steel.

Scale—(Fig. 340 A). A steel rule with graduations.

Scarf—The bevel edge formed on a piece of metal which is to be lap-welded.

SCREW MACHINE TOOLS

Box Tool, Bushing—(Fig. 341). The cutters in this tool are placed with edges radial to the stock and may be adjusted to turn the required diameter by the screws in the rear. The stock is supported in a bushing and must therefore be very true and accurate as to size.

Box Tool, Finishing—(Fig. 342). The material turned in this box tool is supported by adjustable back rest jaws and the cutters are also adjustable in and out as well as lengthwise of the tool body.

Box Tool, Roughing—(Fig. 343). This tool has one or more cutters inverted over the work and with cutting edges tangent to the material. The back rest is bored out the size the screw or other piece is to be turned and the cutter turns the end of the piece to size before it enters the back rest. Sometimes a pointing tool is inserted in the shank for finishing the end of the work.

Collet or Chuck—(Fig. 344). Spring collets or chucks are made to receive round, square, hexagonal or other stock worked in the screw machine. The collet is hardened and is closed in operation by being pressed into the conical cap into which it fits. When released it springs open sufficiently to free the stock and allow it to be fed through the collect.

Drill Holder—(Fig. 340). The end of the drill holder is split and provided with a clamp collar by which the holder is closed on the drill.

Feed Tube—(Fig. 346). The screw-machine feed tube or feed finger is closed prior to hardening and maintains at all times a grip on the stock. The rear end is threaded and screwed into the tube by which it is operated. It is drawn back over the stock and when the chuck opens is moved forward feeding the stock the right distance for the next piece.

Forming Tools—Circular forming cutters are generally cut below center to give proper clearance and the tool post is bored a corresponding amount above center to bring the tool on the center line. Dovetail cutters are made at an angle of about 10 degrees for clearance.

Circular—(Fig. 347).

Dovetail—(Fig. 348).

Hollow Mill—(Fig. 349). Usually made with 3 prongs or cutting edges and with a slight taper inside toward the rear. A clamp collar is used on mill like a spring die collar and a reasonable amount of adjustment may be obtained by this collar. Hollow mills are frequently used in place of box tools for turning work in the screw machine.

Nurling Tool—(Fig. 350). The two nurls in this box are adjustable to suit different diameters of work.

Pointing Tool—(Fig. 351). The bushing in this tool receives and supports the end of the round stock and the cutters carried in the frame form and point the end.

Revolving Die Holder—(Fig. 352). The common type of revolving die holder which is generally used with spring dies, has a pair of driving pins behind the head and in the flange of the sleeve which fits into the turret hole. At the rear end of the sleeve is a cam surface which engages a pin in the shank of the head when the die is re-

versed. The die is run on to the work with the driving pins engaged. When the work is reversed, the cam at the rear engages the pin in the shank and holds the die from turning so that it must draw off the work.

Spring Die and Extension—(Figs. 353–354). Spring dies or prong dies are provided with a collar at the end for adjusting and are easily sharpened by grinding in the flutes.

Spotting Tool—(Fig. 355). This tool spots a center in the end of the bar of stock to allow the drill to start properly, and also faces the end of the piece true. Sometimes called "centering and facing" tool. It is desirable to have the included angle of the cutting point less than that of the drill which follows it in order that the latter may start true by cutting at the corners first.

Screw Plates—Holders for dies for cutting threads on bolts or screws. Dies are usually separate but sometimes cut in the piece which forms the holder.

SCREWS

Cap Screws—Cap screws are machined straight from point to head have finished heads and up to 4 inches in length are usually threaded three-fourths of the length. When longer than 4 inches they are threaded one-half the length, which is measured under the head, except in the case of countersunk head screws which are measured over all. Cap-screw sizes vary by 16ths and 8ths and are regularly made up to 1 or 1¼ inch diameter, while machine screws with which they are frequently confused are made to the machine-screw gage sizes.

Flat fillister heads on cap screws are often called "round" heads; oval fillister heads are frequently designated as "fillister" heads, and countersunk heads as "flat" heads. When a countersunk or flat head has an oval top it is called a "French" head.

Fillister heads are also made with rounded corners as well as with the oval head shown above. Fillister head screws are known in England as cheese-head screws. The included angle of the countersunk or flat head is 70 degrees.

Button Head—(Fig. 356).

Countersunk Head—(Fig. 357).

Flat Fillister Head—(Fig. 358).

Fillister Head, Oval—(Fig. 359).

Hexagon Head—(Fig. 360).

Square Head—(Fig. 361).

Collar Screw—(Fig. 362). Collar or collar head screws are used for much the same purposes as regular cap screws, and, in fact,

are sometimes designated as "collar" cap or "collar head" cap screws.

Machine Screws—Machine screws are made to the sizes of the machine-screw gage instead of running like cap screws in even fractions of an inch.

Button or Round Head—(Fig. 363).

Countersunk or Flat Head—(Fig. 364).

Fillister Head—(Fig. 365).

Set Screws—Set screws are threaded the full length of body and may or may not be necked under the head. They are usually case-hardened. Ordinarily the width of head across flats and the length of head are equal to the diameter of the screw. The headless set screw is known in England as a "grub" screw.

Cone Point—(Fig. 366).

Cup Point—(Fig. 367).

Flat Point—(Fig. 368).

Hanger Point—(Fig. 369).

Cone Point Headless—(Fig. 370).

Headless—(Fig. 371).

Low Head—(Fig. 372).

Flat Pivot Point—(Fig. 373).

Round Pivot Point—(Fig. 374).

Round Point—(Fig. 375).

Shoulder Screw—Shoulder screws are commonly used for carrying levers and other machine parts that have to operate freely. The screw body is enough longer than the thickness of the piece pivoted thereon to allow the latter to work easily when the screw is set up tight against the bottom of the shoulder. With double shoulders, two members may be mounted side by side and left free to operate independently of each other.

Double Shoulder—(Fig. 376).

Single Shoulder—(Fig. 377).

Thumb or Wing Screw—(Fig. 378). A screw with a winged or knurled head which may be operated by hand when a quick and light clamping effect is desired.

Wood Screws—Wood screws are made in an endless variety of forms, a number of which are shown on the following page. They range in size from No. 0 to No. 30 by the American Screw Company's gage and are regularly made in lengths from ¼ inch to 6 inches. Generally the thread is cut about seven tenths of the total length of the screw. The flat-head wood screw has an included angle of head of 82 degrees.

Wood or Lag Screw—(Fig. 379). Lag screws, or coach screws, as they

are often called, have a thread like a wood screw and a square or a hexagonal head. They are used for attaching countershaft hangers to over-head joists for fastening machines to wood floors and for many other purposes where a heavy wood screw is required.

Scriber—(Fig. 379 A). A sharp-pointed tool for marking or "scribing" on metal.

Sector—Any part of a circle. As used in the shop it refers to a device used on an index plate of a dividing head for indicating the number of holes to be included at each advance of the index crank in dividing circles. The sector can be opened or closed to form as large or small an arc as necessary to cover the desired number of holes for each movement of the crank.

Set—A term which denotes a permanent deformation or change in shape of a piece of metal or other material after having been strained beyond its elastic limit. As a spring which will recover its normal shape unless it is bent so far as to be strained and become "set." The term is also applied to the bending of saw teeth, first on one side and then the other, to give clearance in the cut.

Set Screw—See Screws.

Shaft Bearing Stand—A stand or support for a shaft bearing which is fastened to the floor.

Shaft Coupling—See Coupling, Shaft.

Shaft, Flexible—Shaft made of a helical spring or of jointed parts, usually confined in a leather or fabric casing, to transmit power in varying directions.

Shaft, Jack—A secondary or auxiliary shaft, driven by the engine and in turn driving the dynamos or other machinery. Jack shafts are often introduced between a regular machine countershaft and the line shaft.

Shaft, Line—The shafting driving the machinery of a shop or section of a shop by means of pulleys and belts.

Shaft, Muley—A vertical shaft carrying two idler pulleys for carrying a belt around a corner. To be avoided where possible.

Shaper—(Fig. 380). A machine in which the tool is carried on a ram and travels across the work.

Shaper, Crank—A shaper in which the ram is driven by a crank motion.

Shaper, Draw cut—A shaper in which the cutting stroke takes place toward frame of machine. This tends to draw the parts together.

Shaper, Friction—A shaper in which the ram is driven by friction clutches.

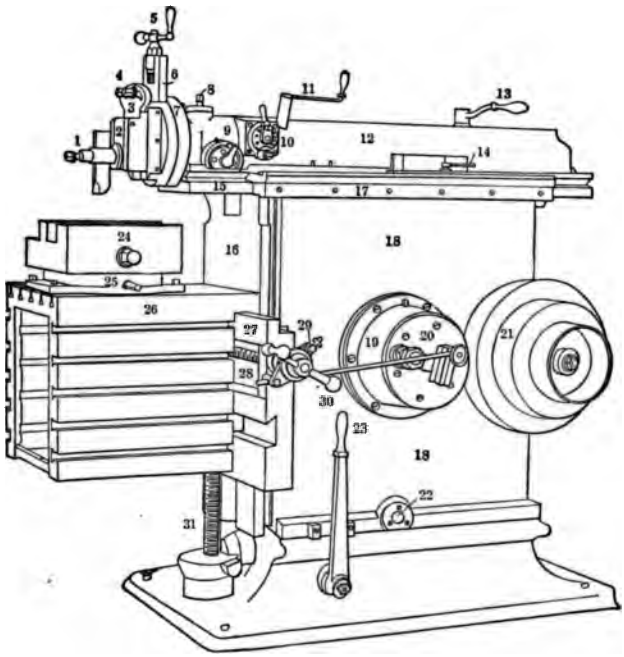


FIG. 380.

Shaper—Parts of

1. Tool post.
2. Clapper block.
3. Clapper box.
4. Clamping bolts.
5. Down-feed screw.
6. Tool slide.
7. Tool head.
8. Binder for head.
9. Stop for down feed.
10. Down-feed adjustment.
11. Ram adjuster.
12. Ram.
13. Position lever.
14. Clamp for down feed.
15. Ram slide.
16. Face of column.
17. Ram guide.
18. Frame or body.
19. Feed box.
20. Feed regulator.
21. Cone-driving pulley.
22. Lever bearing.
23. Power elevation of table.
24. Vise.
25. Swiveling base.
26. Table.
27. Saddle.
28. Cross-feed screw.
29. Cross-feed dog.
30. Cross-feed handle.
31. Elevating screw.

Shaper, Gear—A shaper which planes gear teeth by using a cutter like a pinion that rolls with the gear as it cuts.

Shaper, Geared—A shaper in which the ram is driven by a rack and pinion with a slow cutting stroke and a quick return by shifting open and crossed belts same as on a planer.

Shapers, Traverse or Traveling Head—A shaper in which the ram feeds across work, which is stationary.

Shear—A tool for cutting metals between two blades. The name given to the way or V of a lathe or planer. A hoisting apparatus used on wharves or docks, consisting of two heavy struts like a long inverted V.

Also the name given to the failure of metal or other material when cut by opposing surfaces as in a pair of shears or when a riveted joint fails.

Shears—A name given to the ways on which the lathe carriage and tail stock move are called "shears" by some, "ways" by others. They may be either V, flat or any other shape.

Shear, Alligator—A name given to machine where moving knife or cutter works on a pivot.

Shear, Squaring—A shearing machine which has cutter bar guided at both ends.

Shear, Slitting—A shearing machine arranged for slitting sheet metal. Rotary cutters are usually used in these machines.

Shearing Machine—A machine for cutting off rods, bars or plates.

Shedder—A plate or ring operated by springs or by a rubber pad to eject a blank from a compound die. It acts as an internal stripper, and is sometimes known as an ejector.

Sherardizing—The name given to a new process of dry galvanizing of any iron product.

Shifter, Belt—A device for shifting belts from one pulley to another.

Shifter Fork—An arm or holder to guide belt from tight to loose pulley or vice versa, by pressing the sides.

Shim—A liner or piece to place between surfaces to secure proper adjustment.

Shrink Fit—See Fits.

Slab Milling Machine—Milling Machine, Slab.

Slip Washer—See Open Washer.

Slotted Washer—See Open Washer.

Slot, Dovetail—(Fig. 381). A slot with inclined sides and which is wider at the bottom than at the top.

Slot, T—(Fig. 382). A slot with parallel sides but which is undercut at the bottom to allow a T-headed bolt to slip in for holding down work.

Slotter—(Fig. 383). A machine for planing vertical surfaces. The tool travels vertically in a ram.

Socket—(Fig. 384). A piece which fits the spindle of any machine, as a drilling machine, and which holds the drill or other tool while at work.

Socket, Grip—(Fig. 385). A device which grips and drives drills or other tools as in a drilling machine.

Socket Wrench—See Wrench, Socket.

Sow and Pigs—In casting iron into pigs, the gate or central channel is called the sow and the smaller molds which lay off at the sides are called the pigs.

Sow or Sow Block—A shop name for a chuck to hold work at convenient angles for chipping and filing. Also called a ball chuck.

Spinning—The forming of sheet metal by rolling it against forms. Lamp bodies, vases, and similar work are made in this way.

Spinning Lathe—See Lathe, Spinning.

Spline—A name used in some sections in place of "key" and in others the same as "feather." (See Key and Feather.)

Split Nut—A nut split lengthwise so as to open for quick adjustment.

Spot or Spotting—To make a spot or flat surface for a set-screw point or to lay out from. Scraping a surface for a finish is sometimes called spotting. Also used to denote machinery work with a number of high spots.

SPRINGS

Compression Spring—(Fig. 386). A helical spring which tends to shorten in action.

Flat Spring—(Fig. 387). A spring made from flat stock. Usually fastened at one end while other end presses on piece to be acted upon.

Helical Spring—A spring coiled lengthwise of its axis like a screw thread. Often incorrectly called a spiral spring.

Leaf Spring—(Fig. 388). A built up spring made of flat stock like a carriage spring or locomotive driving spring.

Spiral Spring— Fig. 389). A spring wound with one coil over the other as in a clock spring. Usually of flat stock, but not always.

Tension Spring—(Fig. 390). A helical spring which tends to lengthen in action.

Torsion Spring—(Fig. 391). A helical spring which operates with a coiling or uncoiling action as a door spring.

Valve Spring—(Fig. 392). A helical spring used on valve stems and similar places; each coil being smaller than the one below, in order

that the spring may close up into a very small space and then have a considerable range of action.

Spring Cotter—See Cotter.

Sprue Cutter—A cutting punch for trimming sprues from soft metal castings.

SQUARES

Square—A tool with two blades at right angles or 90 degrees apart.

Caliper Square—A square with a caliper adjustment for laying out work.

Combination Square—(Fig. 393). A tool combining square, level and protractor in one tool.

Center Square—A tool for finding the center of a round bar by placing across the end and scribing lines in two different positions. Also used as a T-square. Not so much used as formerly.

T-Square—A straight edge with a head at one end commonly used on the drawing board for drawing straight lines. It forms a guide also, along which triangles are slid. Generally made of wood, although sometimes of metal and often provided with a swiveling head which serves as a protractor when graduated in degrees.

Try Square—(Fig. 394). A small square for testing work as to its being at right angles.

Stand, Vise—Stand, usually of metal, for holding a vise firmly in any desired part of the shop, making it a portable vise.

Steady Rest—See Rest, Steady.

Steel, High Speed—A name given to steels which do not lose their hardness by being heated under high speed cuts. Alloy steels which depend on tungsten, chromium, manganese, molybdenum, etc., for their hardness.

Stocks, Ratchet—Die stocks with ratchet handles.

Straight Edge—(Fig. 395). A piece of metal having one edge ground and scraped flat and true. Small ones are sometimes made of steel but large, straight edges are usually of cast iron, proportioned to resist bending, and are used for testing the truth of flat surfaces such as plane ways.

Strap—The endless belt covered with abrasive, which is used on belt or strap polishing machines.

Strapping—A method of buffing by the use of a flexible strap or belt, usually made of cloth and covered with abrasive held in place by glue. Runs over two pulleys or one pulley and a rod or plate at high speed.

String Jig—See Jig, String.

Stripper—A thin plate placed over the die, in a punch press, with a gap beneath to admit the sheet stock and an opening to allow

the punch to pass freely; upon the up-stroke of the punch it prevents the strip of metal from lifting with the punch.

Stud, Collar—(Fig. 396). The collar stud forms a satisfactory device for carrying gears, cam rolls, rocker levers, etc. It is often provided with a hole at the end for a cutter pin or is slotted for a split washer, to retain the gear, or other part in place.

Stud, Shoulder—(Fig. 397). A stud of this form is used for mounting levers and other parts which could be operated on a plain, unthreaded stud, which stud, however, cannot be conveniently set or removed when necessary. It is also a form of post or guide sometimes employed in machine construction for carrying one or more sliding parts.

Stud, Threaded—(Fig. 398). Studs are threaded on both ends to length required and screwed tight into place. A nut is run on the outer end. They are commonly used for holding cylinder heads in place and for other purposes where it is desirable that the screw shall remain stationary to prevent injury of threads tapped in the main piece.

SURFACE PLATES

Surface Plate—(Fig. 399). A cast-iron plate having its surface scraped flat for use in testing work. Surface plates should be made in sets of three and so scraped that each one has a perfect bearing with the other two.

Swaging—Changing the sectional shape of a piece of metal by hammering, rolling or otherwise forcing the particles to change shape without cutting.

Swaging Blocks—(Fig. 400). Blocks of cast or wrought iron to assist blacksmith in swaging and bending iron to various shapes. *A* is for use in the hardie hole in the anvil, *B* can be used anywhere but is usually on or beside the anvil.

Swaging Hammer—(Fig. 401). A connection with the swaging block to swage metal to the desired size and shape .

Swaging Machine—A machine for reducing tapering or pointing wire or tubing either between rolling dies or by hammering with rapid blows between dies of suitable shape.

Sweating—Another name for soldering.

Swing of a Lathe—In the United States the swing of a lathe means the largest diameter of the work that can be swung over the ways or shears. In England it means the distance from lathe center to the ways or one-half the U. S. measurements.

Swivel—Any piece which turns or swivels for adjustment as the base of a compound rest or the tool block on a planer.

T

Take-up—The name given to any device which takes up lost motion or slack, as in belts, ropes or other driving mediums.

TAPS

Tap—A hardened and tempered steel tool for cutting threads in a hole. It has a thread cut on it and this thread is partly cut away by flutes running lengthwise of the tool, to form cutting edges.

Bit-brace Tap—(Fig. 402). A tap of any kind, usually a bolt tap, with shank made square to be driven by bit-brace.

Echols Thread Tap—(Fig. 403). This form of tap has every other thread cut away on each land, but these are staggered so that a space on one land has a tooth behind it on the next land. This is done for chip clearance.

Hand, First or Taper Tap—(Fig. 404). Bolt tap usually for hand use. The first or taper tap has the front end tapered to enter easily.

Hand, Second or Plug Tap—(Fig. 405). The second tap with only a small taper to the first two threads. Usually this tap is the last that need be used.

Hand, Third or Bottoming Tap—(Fig. 406). Tap with full thread clear to the end. For cutting a thread clear to the bottom of a hole.

Hob for Pipe Dies Tap—(Fig. 407). A hob tap for cutting threads in pipe dies. Taper $\frac{3}{4}$ inch per foot.

Hob for Solid Dies Tap—(Fig. 408). A tap used for cutting the threads in a solid die. It is best to remove about three-fourths of the stock with a leading tap but is not necessary.

Hob, Sellers Tap—(Fig. 409). A tap having threads in the center and numerous flutes. For hobbing dies and chasers.

Machine or Nut Tap—(Fig. 410). A tap with a long shank small enough to allow tapped nuts to pass over it. After tap is full the tap is removed from machine and nuts slid off the shank.

Machine Screw Tap—(Fig. 411). A tap made with the size and thread of machine screws. Made with shank the size of screw and pointed ends on small sizes.

Master Tap—A standard tap for cutting solid and open dies.

Patch-bolt Tap—(Fig. 412). A tap for boiler-makers use in patching boilers. Sizes vary by sixteenths from $\frac{1}{2}$ inch to 1 $\frac{1}{4}$ inches. All threads are 12 to inch and taper is $\frac{3}{4}$ inch per foot.

Pipe Tap—(Fig. 413). A taper tap, $\frac{3}{4}$ inch taper per foot for pipe fitting.

Pulley Tap—(Fig. 414). A tap with a long shank to reach the hub of pulley for tapping set-screw holes.

Staybolt Tap—(Fig. 415). Tap for threading boiler sheets for stay bolts. The point reams the hole, then comes a taper thread, and a straight thread of right size. Shank is square for driving tap. All standing stay-bolt taps have 12 threads per inch.

Step Tap—Tap made with "steps" or varying diameters. Front end cuts part of thread, next step takes out more and so on to the end. Only used for heavy threads, usually square or Acme.

Stove-bolt Tap—Made same way as machine-screw taps but in only six standard sizes.

Tapper Tap—Similar to a machine tap except that it has no square on the end.

Tap Remover—A device for removing broken taps. Usually have prongs which go down in the flutes and around the central portion.

Taper Reamer—See Reamer, Taper.

Tapped Face-plate—See Face Plate.

Tapping Machine—A machine for cutting threads with taps (tapping) in nuts or other holes.

Threading Tool—A tool for cutting threads in a lathe. It may be solid or have an inserted cutter.

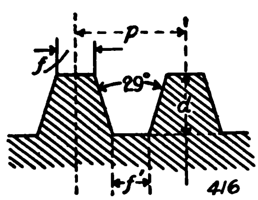
Threading Tool, Rivet-dock—The tool is a rotary cutter with cutting teeth of different depths. The first tooth starts the cut, then instead of feeding the carriage into the work the cutter is turned and the next tooth takes the next cut.

Acme Screw Thread, 29 degree Standard—(Fig. 416).

$$p = \text{pitch} = \frac{1}{\text{no. threads per inch}}$$

$$d = \text{depth} = \tfrac{1}{2}\,p + .010.$$

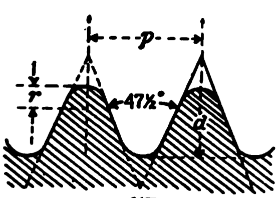
$$f = \text{flat on top of thread} = p \times .3707$$



416

The Acme screw thread is practically the same depth as the square thread and much stronger. It is used extensively for lead screws, feed screws, etc.

Screw Thread, British Association Standard—(Fig. 417).



417

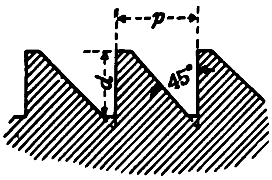
$$p = \text{pitch}$$

$$d = \text{depth} = p \times .6$$

$$r = \text{radius} = \frac{2 \times p}{11}$$

This thread has been adopted in England for small screws used by opticians and in telegraph work, upon recommendations made by the Committee of the British Association. The diameter and pitches in this system are in millimeters.

Screw Thread, Buttress—(Fig. 418).



418

$$p = \text{pitch} = \frac{1}{\text{no. threads per inch}}$$

$$d = \text{depth} = \tfrac{3}{4}p$$

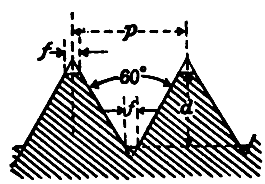
The buttress thread takes a bearing on one side only and is very strong in that direction. The ratchet thread is of practically the same form but sharper.

Screw Thread, International (Metric) Standard—(Fig. 419).

$$p = \text{pitch}$$

$$d = \text{depth} = p \times .6495$$

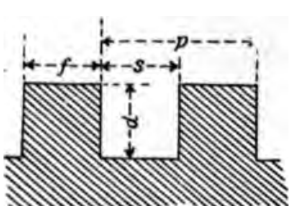
$$f = \text{flat} = \frac{p}{8}$$



419

The International thread is of the same form as the Sellers or U. S. Standard. This system was recommended by a Congress held at Zurich in 1898, and is much the same as the metric system of threads generally used in France. The sizes and pitches in the system are in millimeters.

Screw Thread, Square—(Fig. 420).



420

$$p = \text{pitch} = \frac{1}{\text{no .threads per inch}}$$

$$d = \text{depth} = \tfrac{1}{2}\ p$$

$$f = \text{width of flat} = \tfrac{1}{2}\ p$$

$$s = \text{width of space} = \tfrac{1}{2}\ p.$$

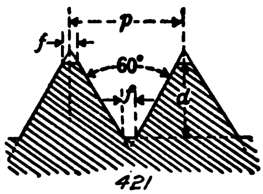
While theoretically depth, width of space and thread are each one-half the pitch, in practice the groove is cut slightly wider and deeper.

Screw Thread, United States Standard—(Fig. 421).

$$p = \text{pitch} = \frac{1}{\text{no. threads per inch}}$$

$$d = \text{depth} = p \times .6495$$

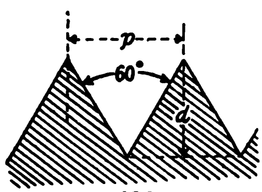
$$f = \text{flat} = \frac{p}{8}$$



421

This thread was devised by Wm. Sellers, and recommended by the Franklin Institute in 1869. It is called the U. S. Standard, the Franklin Institute, and the Sellers thread. The advantages of this thread are, that it is not easily injured, tap and dies will retain their size longer, and bolts and screws with this thread are stronger and better appearing. The system has been adopted by the United States Government, Master Mechanics and Master Car Builders.' Associations, Machine Bolt Makers, and by many manufacturing establishments.

Screw Thread, V, 60 degree Sharp—(Fig. 422).



422

$$p = \text{pitch} = \frac{1}{\text{no. threads per inch}}$$

$$d = \text{depth} = p \times .8660$$

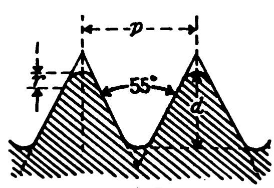
While the sharp V form gives a deeper thread than the U. S. Standard, the objections urged against the thread are, that the sharp top is injured by the slightest accident, and, in the case of taps and dies, the fine edge is quickly lost, causing constant variation in fitting.

Screw Thread, Whitworth Standard—(Fig. 423).

$$p = \text{pitch} = \frac{1}{\text{no. threads per inch}}$$

$$d = \text{depth} = p \times .64033$$

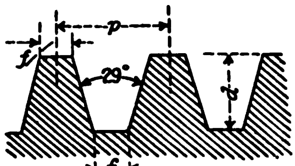
$$r = \text{radius} = p \times .1373$$



423

The Whitworth thread is the standard in use in England. It was devised by Sir Joseph Whitworth in 1841, the system then proposed by him being slightly modified in 1857 and 1861.

Worm Thread, Brown and Sharpe 29 degree—(Fig. 424).



424

$p = \text{pitch} = \dfrac{1}{\text{no. threads per inch}}$

$d = \text{depth} = p \times .6866$

$f = \text{flat on top of thread} = p \times .335$

This thread is commonly used in America for worms. It is considerably deeper than the Acme screw thread of the same angle, namely 29 degrees.

T

Toggle—An arrangement of levers to multiply pressure obtained by making movement given to work very much less than movement of applied power.

Tongs—Tools for holding pieces of metal during forging and other operations.

Bolt Tongs—(Fig. 425).
Gad Tongs—(Fig. 426).
Lathe Tool Tongs—(Fig. 427).
Pick-up Tongs, Double—(Fig. 428).
Rivet Tongs—(Fig. 429).
Straight-lipped Tongs—(Fig. 430).

Tool Box or Chest—(Fig. 431). A place for keeping tools. The old box has given way to the small chest of drawers in most cases.

Tool Holder, Lathe or Planer—(Fig. 432). A body or shank, adopted to hold small pieces of tool steel for cutting tools. These can be removed for sharpening or renewal without moving the holder and saves resetting the tool to the work.

TOOLS, LATHE

Inside Boring Tool—(Fig. 433).
Bull Nose Tool—(Fig. 434).
For Trueing Up Centers, etc.—(Fig. 435).
Bent Cutting-off Too —(Fig. 436).
Straight Cutting-off Too'—(Fig. 437).
Left-hand Diamond Point—(Fig. 438).
Right-hand Diamond Point—(Fig. 439).
Bent Right-hand Diamond Point—(Fig. 440).

Finishing or Necking Tool—(Fig. 441).
Half Diamond Point, R. H.—(Fig. 442).
Round Nose—(Fig. 443).
Scaling Tool—(Fig. 444).
Left-hand Side Tool—(Fig. 445).
Left-hand Bent Side Tool—(Fig. 446).
Right-hand Side Tool—(Fig. 447).
Right-hand Bent Side Too—(Fig. 448).
Bent Threading Tool—(Fig. 449).
Inside Threading Tool—(Fig. 450).
Straight Threading Tool—(Fig. 451).
Water Polishing Tool—(Fig. 452).

TOOLS, PLANER

Bull Nose, for Heavy Cuts—(Fig. 453).
Left-hand Bevel Tool—(Fig. 454).
Right-hand Bevel Tool—(Fig. 455).
Broad Nose or Stocking Tool—(Fig. 456).
For Finishing in Corners—(Fig. 457).
Cutting-off Tool—(Fig. 458).
Left-hand Diamond Point Tool—(Fig. 459).
Right-hand Diamond Point Tool—(Fig. 460).
Gouge Nose Tool—(Fig. 461).
Scaling Tool—(Fig. 462).
Left-hand Side Tool—(Fig. 463).
Right-hand Side Tool—(Fig. 464).
Left-hand S ding tool—(Fig. 465).
Right-hand Siding Tool—(Fig. 466).
Smoothing Tool for Cast Iron—(Fig. 467).
For Smoothing Wrought Iron or Steel—(Fig. 468).

Tote Box or Pans—Boxes, pans or trays of steel for carrying small parts from one part of shop to another.

Train—A name given to a series of gears, as in the feed train of a lathe, connecting the spindle to the lead screw. The name is sometimes applied to a series of levers.

Trammels—(Fig. 469). An instrument for drawing large circles. Fit on a beam and their capacity depends on the length of the beam.

Trepanning Tool—A tool for cutting an annular groove outside or around a bored hole. Similar to a flue sheet cutter.

Tripper—Any device that trips any piece of mechanism at the desired time. An example is found in conveyers where the tripper dumps the material at the desired point.

Tumbler Gear—(Fig. 470). An intermediate gear which meshes in between other gears to reverse the direction of the driven gear of the train.

Tuyere—The pipe or opening into the bottom of the fire pot of a forge, through which the air blast is forced.

V

VISES

Bench Vise—(Fig. 471). A device consisting of a body, which is fastened to the bench and a movable jaw, for holding work to be worked on in any way.

Chipping or Filing Vise—A heavy bench vise designed to stand the shocks from chipping.

Drill Vise—(Fig. 472). A vise for holding work to be drilled.

Hand Vise—(Fig. 473). A small vise to be held in the hand. For small work that needs to be turned frequently to get at different sides.

Jig Vise—(Fig. 474). A drilling vise with arms which carry bushings so that pieces can be drilled in duplicate without special jigs.

Pin Vise—(Fig. 475). A small hand vise for holding small wire.

Vise Stand—(Fig. 476). A portable stand so that a vise can be moved to any part of the shop.

Volt—The unit of electrical pressure.

W

Washer—(Fig. 477). A piece of metal with a hole through it to go under a nut, bolt head or rivet.

Washer, "C", Open or Horseshoe—(Fig. 478). A washer with one side open to be easily slipped on or off a bolt without taking off the nut.

Watt—The unit of electrical power and equals volts multiplied by amperes. 746 watts are equal to one horse-power.

Ways—The guiding or bearing surfaces on which moving parts slide, as in a lathe plane or milling machine. The ways may be of any form, flat, V or any other shape.

WELDS

Butt Weld—(Fig. 479). A weld made by butting two ends or edges together.

Crotch Weld—(Fig. 480). A weld in which one piece is cut with a V or crotch, to receive the other piece.

Lap Weld—(Fig. 481). A weld in which the ends or edges lap over each other before being welded.

Scarf Weld—(Fig. 482). A weld in which the ends are beveled or "scarfed" before welding.

Welding—The joining of metals by heating the parts to be joined to the fusing point and making a union by hammering or forcing them together. Welding in an open fire is usually confined to iron and steel but nearly all metals can be joined in this way by electric heating.

Wind—Pronounced with a long *i* as in "mind" and refers to a twist or warping away from straightness and parallelism.

WRENCHES

Wrench—A device for turning nuts, collars, pipe or other pieces.

Wrenches, Machine—Wrenches made for use in various kinds of machine work.

Fifteen degree angle wrenches have an opening milled at an angle of 15 degrees with the handle, which permits the turning of a hexagon nut completely around where the swing of the handle is limited to 30 degrees.

Twenty-two and a half degree angle wrenches have an opening which forms an angle of 22½ degrees with the handle, which permits the turning of any square head bolt or screw completely around where the swing of the handle is limited to 45 degrees.

Unfinished drop-forged wrenches are plain forgings, with openings milled to fit the nut or screw on which they are to be used.

Semi-finished wrenches are milled to fit the nut or screw on which they are to be used and case-hardened all over.

Finished wrenches are milled to fit the nut or screw on which they are to be used and are ground, polished, case-hardened all over, lacquered, with heads bright.

Box Wrench—(Fig. 483).
Chuck Wrench—(Fig. 484).
Key Wrench—(Fig. 485).
Set Screw Wrench, Double End—(Fig. 486).
Set Screw Wrench, Single End—(Fig. 487).
Set Screw Wrench, Triple End—(Fig. 488).
Socket Wrench—(Fig. 489).
Spanner Wrench, Hook—(Fig. 490).
Spanner Wrench, Pin—(Fig. 491).
Spanner Wrench, Pin Face—(Fig. 492).